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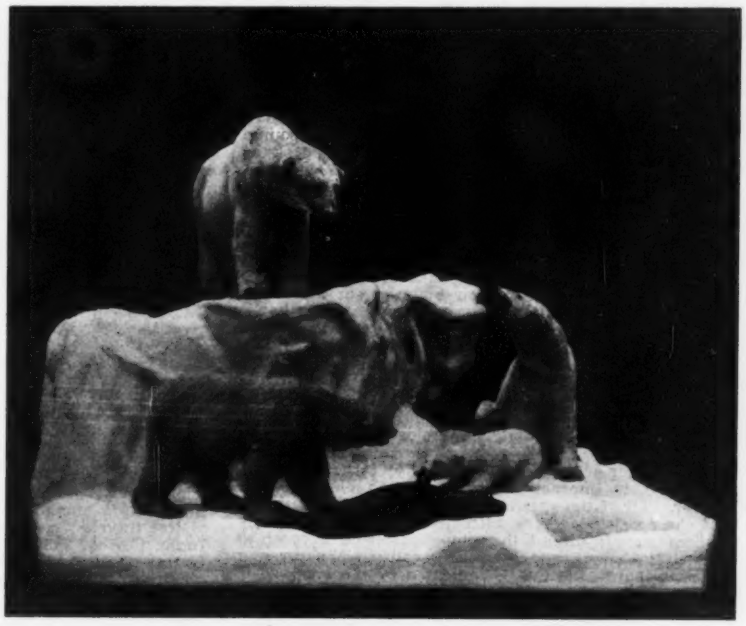
THE FIELD COLUMBIAN MUSEUM.

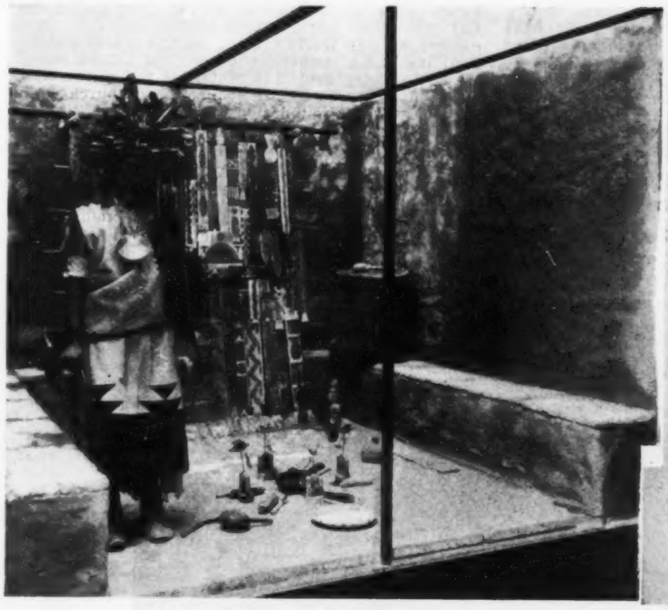
THE Annual Report of the Director of the Field Columbian Museum at Chicago, Prof. Frederick J. V. Skiff, is most interesting. It will be remembered that the Field Columbian Museum occupies the building formerly known as the Art Gallery, extensive additions having been made to it rendering it admirably adapted for the display of scientific and historical material, the scope of the museum being a very wide one. Our engravings represent a few of the notable points of interest. We have on other occasions given views in the halls devoted to the transportation exhibits.

The rotunda of the main building of the museum is devoted to an artistic memorial of Columbus and of

GROUP OF GREAT KOODOO.



GROUP OF POLAR BEAR.



ORAIBI OÖQOL INDIAN ALTAR AND MAID.

HIND LEG OF MOROSAURUS.

HALL OF MESOZOIC FOSSILS.

THE FIELD COLUMBIAN MUSEUM, CHICAGO, ILL.

the Columbian Exposition. The central piece is the statue of the great discoverer, which with uplifted hands is consecrating the new world. This at once attracts attention both as an historical study and a masterpiece of art. It is by Augustus St. Gaudens. The original sketch, models of the figures and groups of the figures ornamenting the main Exposition Building were donated by the Exposition to the museum and occupy the entire space around the statue. They are invaluable as works of modern art, representing the genius of some of the most talented of our American sculptors. A sketch of D. C. French's statue of the Republic is important. The thirty-five sketches by Karl Bitter for the statuary on the Administration Building are also important.

The Department of Geology.—The collections gathered in the Department of Geology are designed to illustrate the history of the earth's development and the materials which form its crust. Since, however, as the science of geology has both a theoretical and a practical side, a division of the collections has been made in order to present these two phases of the subject. Those illustrating geology as a theoretical science are to be found in the division of Systematic Geology. Those showing it in its relation to human arts and industry are in the division of Economic Geology. The division of Systematic Geology is divided into six sections—palæontology, geography, geology, meteorites, systematic mineralogy, structural and dynamic geology and lithology. These sections illustrate in order first the life of the globe from its earliest beginnings to its latest and highest forms; second, the configuration and mode of formation of the surface of the earth; third, the bodies which come to us from regions outside the earth which furnish the only material source from which we can learn the composition and structure of heavenly bodies; fourth, the component minerals of the earth's crust classified according to their chemical composition; fifth, aggregations of these in rocks; and sixth, the effects produced by physical forces in forming and shaping the materials of the crust. The arrangement of the specimens under each section follows that of some standard textbook on the subject, so that each section may be considered as illustrative of such textbooks, or, on the other hand, they may be referred to for a fuller description of the specimens or discussions of the subject presented. In the section of palæontology it is sought to illustrate by fossils, casts and models the animal or vegetable formations which have characterized the life of the globe at the succeeding stages of its history. The arrangement is primarily chronological and secondly zoological.

The center of the hall is occupied by large specimens which it is impracticable to place in chronological order. All of the specimen labels show first the name of the species together with that of the authority by whom named; second, the geological period or epoch to which it belongs; third, the locality. Wherever a cast is shown, the fact is indicated by the label, so it may not be confounded with the original specimens. One of our engravings represents the Hall of Mesozoic Fossils, and another of our engravings shows the hind leg and portions of a morosaurus, whose height exclusive of the base is 10 feet 11 inches, and was collected by the Wyoming Expedition in 1899.

Geographic Geology.—Leaving the interesting palæontological halls, the visitor next takes up geographic geology. The purpose of this collection is to illustrate in a vivid and realistic way the surface configuration of the earth. The chief feature of the exhibit is a series of relief maps which reproduce on a natural and representative scale as practicable the topography and structure of the selected portions of the earth's surface. Part of the series shows only topography and sculpture, while another part shows geological structure as well as topography. To some extent topography is shown on one map and the geological structure on another, so that both elements are represented with the greatest distinctness, in addition to the relief maps and models showing geological structure or illustrating methods of development. The collection of meteorites includes 224 distinct "falls" or "finds," represented by 4,100 specimens and having an aggregate weight of 4720.6 pounds. They are grouped in three classes, siderites or iron meteorites, siderolites or ironstone meteorites and aerolites or stone meteorites.

Systematic Mineralogy.—The systematic collection of minerals numbers about 5,000 specimens. The arrangement of the collection is based upon that given in Dana's "New System of Mineralogy," and so far as possible the purpose has been to illustrate the different species there described.

Structural and Dynamic Geology.—The specimens exhibited in this hall illustrate the materials of the earth's crust and the processes of change which they undergo. They also illustrate many striking phenomena met with in the strata of the earth's crust which are sometimes grouped under the title of "Phenomenal Geology."

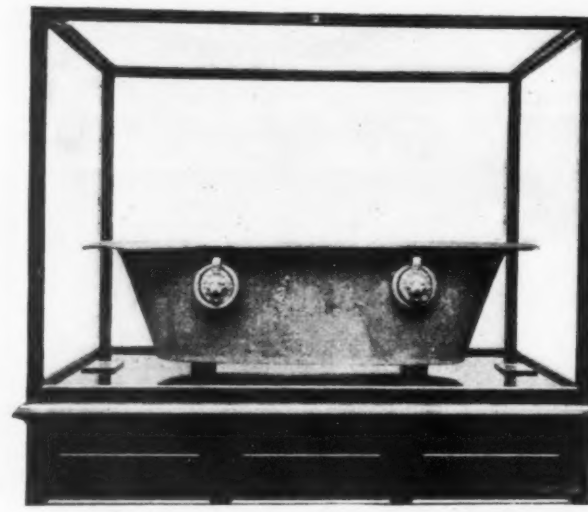
Lithology.—The collection shown in the hall devoted to lithology aims to illustrate the different varieties of rocks as they are known to petrographers and also to exhibit the characteristics of these rocks and their order of succession as they appear in different localities. About 2,000 specimens are shown, most of them being of uniform size adopted in petrography—$3 \times 4 \times 1$ inch. The specimens are classified under the heads of "eruptive," "aqueous" and "metamorphic" rocks.

Economic Geology.—It is the purpose of the collection shown in the Division of Economic Geology to illustrate the modes of occurrences in nature of minerals and ores which have economic importance, to show the localities in which they are obtained, the processes used in their extraction and treatment, and their application to human arts and industries. They may be conveniently classified in five groups in building stone—the quarry products, carbon minerals, including coals, petroleum, etc., ores and products of precious metals, ores and products of useful metals, glass, sands and ore of alkalies and alkali.

Department of Zoology.—The collection in zoology is very large. Mollusks, fishes and reptiles, jelly fish, corals, insects, crustaceans and mollusks being represented. The Department of Ornithology comprises a large number of mounted specimens comprising upward of 540 species. Two of our engravings represent some of the fine groups of the mounted animals which are displayed.

Department of Botany and Plant Economics.—This department occupies the galleries of the North, South, East (in part) and West Courts of the main building, and may be reached by any of the four flights of stairs in the central rotunda, or by the stairways at either side of the east and west main doors.

The collections of this department comprise, in the main, those of the foreign governments in forestry, as exhibited in their Government Buildings, and in the Forestry Building at the World's Columbian Exposition; the major portion of the gums, oils, medicinal plants, tan barks, dye woods, seeds and fibers exhibited by the foreign countries in the Agricultural and Manufactures Buildings; the Economic Plant Exhibit of the U. S. Government as exhibited in the Government Building, and portions of many American exhibits in this important branch of natural science.

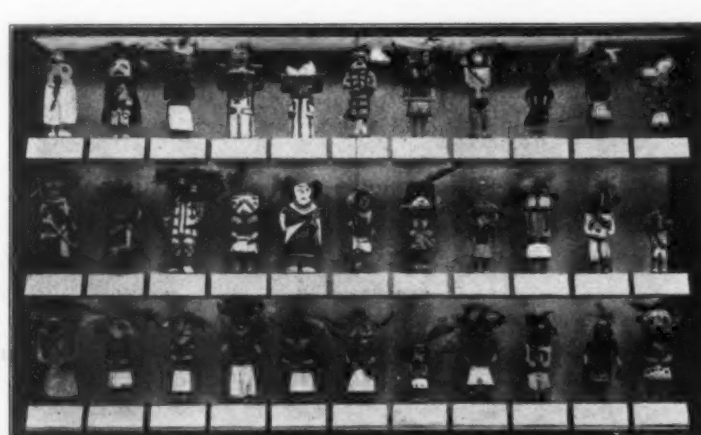


ANCIENT BRONZE BATH TUB. VILLA BOSCA REALE, ITALY—FIELD COLUMBIAN MUSEUM.

The general arrangement of the department is as nearly geographic in character as is possible. Beginning at the northeast corner of the South Court the visitor travels westward through Russia, Corea, Japan, India, Ceylon, Johore, Siam, Turkey, Spain, and Australia; thence, beginning at the Straits of Magellan, northward through Argentine, Paraguay, Brazil, Venezuela, Trinidad, British Guiana, Ecuador, Colombia, Guatemala, and Mexico, to the United States as far as Alaska, meeting there the starting point, Russia.

The special aim in the installation of the objects in this department has been to insure scientific arrangement, although enough display has been made to attract and please the general visitor; especially has this been done when possible without detriment to the natural sequence of species. Sufficient time has not yet elapsed to study into the correctness of all the identification labels attached to the specimens when received, and which have so far been principally retained. This should be borne in mind by those who desire to enter into discriminate study of the collections. All the identifications are being determined by the head of this department as rapidly as is consistent with careful and systematic results, and printed labels substituted for the originals.

Department of Anthropology.—The collections brought together in the Department of Anthropology are intended mainly to illustrate the more primitive or uncivilized phases of the development of the human race. There are two well-marked divisions of the subject, and the materials illustrating them are separately installed. One relates to man himself, to his physical and mental constitution and powers, and the other to the works of his hands, to the visible phenomena of culture.



HOPI KATCINAS OR TIHUS (ONE-TWELFTH OF ENTIRE COLLECTION) STANLEY McCORMICK EXPEDITION—FIELD COLUMBIAN MUSEUM.

The first division consists of apparatus used in studying the greatly varied physical phenomena, and of extensive collections of crania, casts and other objects, articles and materials, illustrating the physical characteristics of the race. These exhibits are arranged in the gallery of the East Court.

The second division comprises very extensive exhibits of the handiwork of man, which are placed on the main floor of the courts and the halls of the southeast section of the building.

The works of living or historic peoples are, for the most part, assembled according to the tribe or nation to which they pertain; those of prehistoric peoples are brought together in groups according to the locality from which they are derived, or to the people, time or stage of progress they are thought to represent, or, otherwise, with reference to some other special subject to be illustrated.

The various groups thus indicated are placed in the halls in an order corresponding, as far as possible, with their original geographic relations. In this way the various objects and articles, and through them the people represented, are conveniently studied and compared. It is also possible, with this arrangement, to illustrate the striking and profound effect of environment—the local animal, vegetal and mineral resources and the varied geographic and climate conditions—upon the people and culture of each region.

Certain collective exhibits are brought together in separate rooms to illustrate special subjects, or to facilitate comparative study in some important direction. This is exemplified in alcove 122, where numerous examples of religious art are assembled, and in Hall 1, which contains an exhibit of musical instruments.

Origin of Collections.—As to their origin, the exhibits may be grouped in three principal categories: (1) Collections made for the World's Columbian Exposition by its Anthropological Department and turned over to the Museum at the close of the Fair; (2) collections from various sources exhibited by the owners at the World's Fair, in the Anthropological Building and elsewhere, and acquired by the Museum by gift or purchase; (3) materials not shown at the Fair, but acquired by gift, collection or purchase subsequently to the foundation of the Museum.

Of the first class the more notable are ethnological collections from Alaska, British Columbia, Canada, California, and the Middle and Eastern States; casts of Mexican, Central American and Peruvian antiquities; and archeological collections from Ohio Mounds. Of the second class are a collection of North American ethnological material donated by Mr. Edward E. Ayer; the Hassler collection of featherwork and other ethnological specimens from the Indians of Paraguay; the Montez collection of Peruvian antiquities; the Wyman collection of copper implements and relics of stone from Wisconsin; the Gunning collection of idols; the Columbian collection of objects of gold, earthenware and stone; the Boas collection of skulls; the Riggs collection of archæologic material from the Southern States; the Johnson collection of reproductions of Irish antiquities; the Finsch collection from New Guinea; the Peace collection from New Caledonia; the Remenyi collection from South Africa; the Pogosky collection from Siberia; contents of a Chinese temple; the Green cliff house collection; the Javanese collection; the Lumholtz collection of ethnological objects from Northern Mexico; and various collections from Alaska. Of the third class are

Pueblo models, pottery and quarry material donated by the Bureau of Ethnology and National Museum; Berlin collection of Egyptian casts; Harris collection of Peruvian antiquities; Bruce collection from Alaska; collection of Mexican antiquities donated by Mr. Allison V. Armour; the great collections of Mr. Ayer from Italy and Egypt, and the Keam collections from the ancient Pueblo region of Arizona.

The collection of archæological specimens from America and abroad is very large and important. In addition to the subjects named above there are various miscellaneous collections which are very interesting, such as musical instruments, textiles, ceramics, agricultural machinery and transportation.

The Division of Transportation.—This collection is of the greatest importance. All methods of marine and land conveyance are included, except the steam railway, which may be regarded as the culmination of the series of exhibits which are installed in the six halls. The originals are arranged in the order of development, beginning with the floating log and human burden-bearers and pack animals, continuing through the methods of the utilization of man and animals for traction, sledges and vehicles with wheels, and ending with the street car, which, when hauled by animals, marked the beginning of the present railway system. The objects of this section, with very few exceptions, were acquired from the Department of Transportation exhibits at the Columbian Exposition.

Transportation by Steam.—This division of transportation, occupying the East Pavilion, is designed to illustrate, largely through full-sized reproductions and originals, the evolution and development of Permanent Way, Structures, Motive Power, Equipment and Appliances. The nucleus of this representation is in the extensive collection made by the Baltimore & Ohio Railroad Company for the Columbian Exposition, and purchased by the Field Columbian Museum. This collection embraces thirty-eight full-sized working reproductions, covering the period from the initial idea of steam propulsion on land, 1680, to the first "Camel" engine of 1848, and nine original locomotives, including examples of the practice followed from 1832 to 1876. In addition, there are nearly eighteen hundred uniformly mounted and framed examples in original wash-drawings, detail plans, photographs, prints, and lithographs, illustrating the evolution and development of the railway in every land where the locomotive whistle has been heard.

The interesting collection made by the Pennsylvania Railroad Company for the Exposition is also in the Museum, and it tells in a graphic and instructive manner the story of the progress of this great railroad corporation by series of models and originals. The Baldwin Locomotive Works contributed the full-sized working reproduction of the "Old Ironsides," the first of the Baldwin engines, and the Rogers Locomotive Works the full-sized working reproduction of the "Sandusky," the first Rogers engine. The Philadelphia & Reading Company contributed the "Rocket," the original No. 1 on that road; the Illinois Central Company the "Mississippi," the original first locomotive in the Gulf States; the Chicago & Northwestern Company the "Pioneer," the original first locomotive west of Chicago, and the Mount Washington Railway the original engine, the "Peppersauce," the first mountain-climbing locomotive in the world. The World's Exposition, through the Chief of the Department of Transportation, presented to the Museum the "Samson" and the "Albion," the original first and second locomotives in Nova Scotia, together with the original first passenger car in that country and the two original first cars drawn on rails by a locomotive in the world, those from the Merthyr Tydvil tram road in South Wales.

In each case the engines and the originals are reproduced standing upon either the original or an exact counterpart of the track of that period.

There is also a library and reading room. The lecture room is reserved for all public meetings, etc., held in the museum. Courses of popular lectures on travels, expeditions and investigations, and on scientific and technical subjects are here given on Saturday afternoons in March, April, October and November by the curator of the museum and prominent investigators and scientists. The lectures are usually illustrated with the aid of a lantern. The lunettes on the sides of the room are occupied one by a scene in Homeric Greece, by F. D. Millet, and the other illustrating a typical industry, that of pottery, is by L. K. Earl. There are also various statues.

The museum is of vast size, and the collections which fill it are well worth taking a long journey to see.

SEARCHLIGHT SIGNALING AT THE PAN-AMERICAN EXPOSITION

FROM THE ELECTRIC TOWER OF THE EXPOSITION TO THE OBSERVATION TOWER AT NIAGARA.

By ORRIN E. DUNLAP.

RECENT wars have brought searchlights prominently before the people, and they have read how, in both the army and the navy, projectors have been successfully used for transmitting messages across land and water. To many, no doubt, the manner in which this is accomplished has been more or less of a mystery, but through the operation of the great and wonderful searchlights to be used in connection with the electrical display of the Pan-American Exposition, much that heretofore has been mysterious will be made clear, and the public will marvel at the present-day facilities for casting powerful beams of light many miles on missions of peace, or to pick out from the darkness the lurking-place of a hidden enemy.

During the months in which the Pan-American Exposition is to be held on the Niagara frontier, the Niagara-Buffalo region is to be the scene of the greatest searchlight exhibition ever witnessed. This display will have a material tendency to educate the visitors to the Exposition in regard to the wide field in which searchlights may be applied for various purposes, while it will also serve to demonstrate very fully the extent to which electrical science has advanced in this respect during the last few years.

In the Niagara-Buffalo locality there is such a bounteous supply of electricity developed for the use of mankind that all visitors to the Exposition will look forward to being entertained by unusual displays and features. Naturally they will expect that, inasmuch as Niagara is the greatest electrical storehouse in the world, the features that will be attached to and operated by its current supply will be of unusual character, magnitude and brilliancy, and in this respect there will be no disappointments. Never yet has an event of the character of the Pan-American Exposition been so rich in its electric power advantages, and for miles and miles along the Niagara border; for miles and miles on every side of Buffalo and the Exposition grounds; for miles and miles across the country of King Edward, even to Hamilton and Toronto, there will flash through the sky wonderful beams of light projected from the lamps operated by Niagara power.

Progress is the inspiring word of the Pan-American Exposition, and its extent is well defined by the determination of the management to make the night scene of the Exposition a feature of wondrous beauty. It is but a few years ago that the opening of an exposition at night would have been an impossibility, owing to the lack of lighting facilities, but with the coming of the twentieth century the artificial lighting has attained such wonderful prominence that enthusiastic persons are found who predict that the Pan-American Exposition will be far more wonderful by night than by day. With the sinking of the summer sun in the West, the vast power supply of Niagara will be called into service, and as the light of the sun becomes dim, the light of Niagara will intensify in brilliancy. It will be the greatest transformation scene the world has ever looked upon, this change from day to night at the Pan-American, and it will be welcomed with somewhat the same delight and spirit as the inhabitants of the Arctic zone greet the Aurora Borealis, or Northern Lights, during the winter of the northern hemisphere, when their long and dreary night is made brighter by this strange light.

Throughout the Exposition grounds, and on the various beautiful buildings, hundreds of thousands of electric lights will be burning in all their beauty, and high over the entrancing, favored spot will rise an auroral arch that will command attention miles away. Like the luminous arch of the Aurora Borealis, it will remain visible for several hours of the night, and from its crown there will shoot forth rays that will meet responding rays many miles distant. These pronounced and brighter rays will come from the two powerful 30-inch projectors to be placed on the 360-foot level of the Electric Tower, while the rays that will be met miles away from the Exposition grounds will come from a projector of similar capacity and brilliancy to be installed on top of the great Observation Tower at Niagara Falls, more than twenty-two miles away.

Through the sky these wonderful beams of light will flash with the rapidity of lightning. There will be no fading to their brightness, but they may flutter like a ribbon in the wind when being changed from point to point about the locality. At the zenith of the sky, midway between Niagara Falls and Buffalo, the two great beams of light will meet as though in apparent effort to pierce the celestial sphere. Thus placed, they will form a crown of light for the Pan-American Exposition, which is to be a marvelous demonstration of the prosperity, the influence and the greatness of the American people.

In this spectacle of the sky there will also be presented a remarkable junction of the forces of the two great power plants of Niagara. The searchlights of the Electric Tower will be operated by electricity generated in the central station of the Niagara Falls Power Company at Niagara Falls and transmitted over miles of cable to the Exposition grounds, while the searchlight of the Observation Tower will be operated by electricity supplied by the central station of the Niagara Falls Hydraulic Power and Manufacturing Company of Niagara Falls. Thus a long distance from both Buffalo and Niagara the forces of these two power plants will meet high in the sky, signalizing the perfect unity with which the people of the Americas acted to make the Pan-American Exposition a success and a truthful portrayal of their progress.

It is the expressed opinion of experts that the beams of these powerful searchlights can be thrown from 50 to 75 miles. This is indeed a long distance, but the penetrating powers of the lights will be increased by the fact that they will be operated at a height of over 300 feet. It is expected that the searchlight on the Observation Tower at Niagara will be visible across Lake Ontario in Toronto, while the beams of the Niagara and Buffalo projectors may be concentrated with good effect on Lockport, or some point of similar distance, with very fine results. As the beams of the projectors sweep across country, the residents of the villages and country places will enjoy the illumination. The beams of the searchlights on the Electric Tower may be cast far up Lake Erie to give greeting to the heavily-laden boats that will enter Buffalo's harbor, or they may be directed out to East Aurora to bring Elbert Hubbard and his Roycroft shop under searchlight inspection, their brilliancy carrying a message that will compete with the famous message to Garcia for public recognition.

While these searchlights will be pleasant to look upon and watch, they will also carry with them education and knowledge to all who seek to learn. In all the papers of the locality within a radius of 75 or 100 miles, the Morse and Meyer's alphabets may be published in order that the public may become familiar with them, and then there will be much pleasure in taking or receiving the announcements which may be made by the searchlight flashes. In the army both the Meyer and the Morse alphabets are used, while the navy confines itself to the Meyer entirely. The Meyer code is usually carried out by means of a flag moved to and fro, right and left, starting from the center. It is evident that a beam of light cast by a searchlight can be utilized in the same manner, a combination of movements making letters. It is known that the commanding officer of the Fourth Brigade, National Guard, State of New York, has had his attention directed to the opportunity presented by the Pan-American searchlights for conducting signal operations, and the officers may avail themselves of these facilities to obtain practice in the transmission of signals and messages, while at the same time they may gain much experience and information as to the distances such signals can be transmitted.

A valuable feature of the searchlights in connection with the Exposition will be that they can be used to illuminate details of sculpture in and about the grounds, while their rays may be concentrated at any spot desired in the grounds during unusual and special occasions.

The projectors to be used on the Electric Tower of the Pan-American grounds, as well as the one to be installed on the Observation Tower at Niagara Falls, will be of General Electric Company make. They will be of the very latest design, and will combine all the very latest improvements. In general appearance they will be compact and graceful, but built to withstand more than ordinary hard usage. Their simplicity of construction, efficiency of operation and durability of service will be very pronounced. They will be fitted with the Margin ground glass silver-plated mirrors, which type of mirror has two spherical surfaces of different radii, and the reflection and refraction of the glass will cause the rays of light to be projected in parallel beams when the arc is in focus. The lamps of the searchlights are designed to throw the greatest possible amount of light on the reflector, and screen shutters are provided to prevent the direct rays from leaving the projector, so that all the rays of light are reflected and sent out parallel. The 30-inch projectors consume 80 amperes of current with from 49 to 53 volts at the arc. The searchlights to be used in the display in question will be hand-operated, so the beam of light can be trained vertically or horizontally by the operator, who will stand close beside the projectors and move the barrel in any direction he may desire. In the case of electrically controlled projectors, the apparatus may be operated at a distance. This is accomplished by having electric motors mounted in the base of the projector, one motor operating a train of gears controlling the vertical movement, and the other motor operating another train of gears controlling the horizontal movement of the projector. The movement of the beam of light corresponds to the movement of the handle of the controller, and both horizontal and vertical movement can be obtained at the same time. When the handle of the controller is released, it is brought back by a powerful spring to the neutral position. It is worthy of note that all projectors are very accurately balanced, and that when it is desired to have a beam of light covering a wide area, a front or divergent door made up of strips of glass, ground plano convex, each strip being a lens, with the convex side outward, is placed in position, which diverges the beam, but does not increase its height.

There is no doubt but what visitors to the Pan-American Exposition will gain a vast amount of information about searchlights and their beautiful effects. In fancy we can picture the turbines of the deep Niagara wheel-pit in full operation, giving life to the generators in the dynamo room above. We can see the current passing to the transformer station at the Falls and then speeding at increased voltage to Buffalo, there to be reduced in voltage before passing to the Exposition grounds. We can imagine still further reductions in the voltage at points on the grounds, and then witness the bright and wonderful beam from the searchlights. Another picture to look upon in fancy is the station at the water's edge at the Niagara gorge, where the current of the Niagara searchlight is generated. It passes from the station to the projector, and the answering beam flashes across the country to meet the beam impelled to brightness by the turbines in the mighty pit, a great, grand and glorious demonstration of the wonders of the Electric Age.

CONTEMPORARY ELECTRICAL SCIENCE.*

MAGNETIC IMAGES.—A brilliant series of researches on magnetic images has been carried out by H. Jaeger. His first experiments were made with a linear conductor and thick steel or iron plates. He showed that the latter modified the field in such a manner as if there were another linear current in the positive of the optical image of the first as reflected in the plate. This is the well-known magnetic image effect. The author proved further, with the aid of a solenoid instead of a linear conductor, that the property of ferromagnetic substances, by virtue of which they produce magnetic images, is a function of their hardness. As the mechanical hardness increases the image effect decreases. An interesting development of the magnetic image is the "kaleidoscopic" effect obtained by the author by means of two plates inclined at an angle to each other, between which the conductor passes. The resulting field is the same as if further conductors were placed in the positions of the multiple optical images of the real conductor. The author suggests the examination of curved ferro-magnetic mirrors, which may lead to startling results.—H. Jaeger, Ann. der Physik., No. 2, 1901.

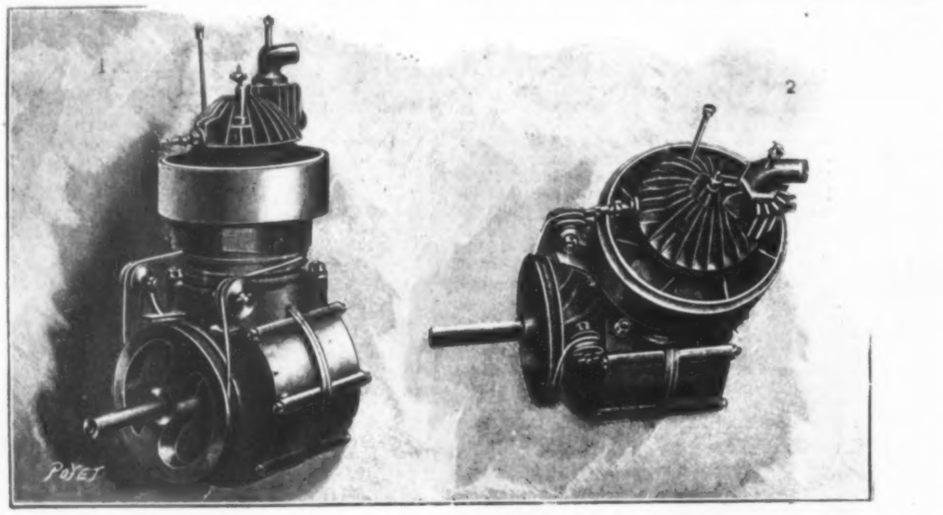
THERMO-LUMINESCENCE DUE TO RADIUM RAYS.—The fluorescence produced by radium rays is, generally speaking, feeble, and can only be perceived in a completely darkened room with thoroughly rested eyes. But E. Wiedemann has found that an intense thermo-luminescence can be produced comparatively easily. He used the radium preparation by Rousseau & Company, Paris. The preparation was contained in a hole 8 millimeters wide sunk into a glass plate 3 millimeters thick. A piece of aluminium foil was stuck over the hole, thus keeping the substance safe from moisture. The detective substance employed for thermo-luminescence was the solid solution of manganese sulphate in calcium sulphate. This was spread in a thin layer on a piece of aluminium foil 6 centimeters square, and covered with a sheet of mica. The radium preparation was laid upon it, and left so for several hours. The aluminium foil was then placed

* Compiled by E. E. Fournier d'Albe in The Electrician.

upon a heated copper plate. At the place where the radium preparation had lain a green circle shone out, visible at some distance. That the solid solution named is only feebly incited to phosphorescence, but strongly to thermo-luminescence, by radium rays, is paralleled by its behavior under the influence of discharge rays, and shows that both kinds of rays exert an influence upon the structure of the substance.—E. Wiedemann, Phys. Zeitschr., February 2, 1901.

THE KAINZ MOTOR.

THE Kainz motor, illustrated herewith, is an apparatus which makes 1,800 revolutions a minute, in which the sparking is effected electrically, and the single cylinder of which is 3.4 inches in diameter, with a piston stroke of 3.8 inches. It operates perfectly as long as sufficient air enters to assure the cooling; but the admission of air is quite a difficult matter to effect under ordinary circumstances, and so Herr Kainz has devised a very original arrangement for the purpose.



KAINZ GASOLINE MOTOR.

The cylinder is surrounded by two bands of aluminium arranged concentrically one above the other and provided internally with blades set diagonally. The blades of the lower ring are directed toward the right and those of the upper one are toward the left. The entire system is operatively connected with a channeled pulley placed externally to and parallel with the crank chamber. The whole revolves upon ball bearings and is set in motion by a pulley mounted upon the shaft of the motor, and through the intermedium of a belt that passes over two small guide pulleys fixed upon brackets cast in a piece with the crank chamber. In this way is obtained a system of blowers to which is communicated a very rapid motion. The air is attracted by the action of the diagonal blades and sent against the cylinders. Then it rises and reaches the cylinder cover, and is finally forced to flow around the combustion chamber through the intermedium of the diagonal blades. In this manner the cylinder is constantly involved in a continuously renewed current of air. It takes but a slight amount of power to set this small blower in operation. In describing this system of cooling we have no intention of especially recommending the Kainz motor (the actual value of which we do not know), but merely desire to point out the particularly interesting arrangement of it. The cooling of gasoline motors, especially when it is a question of those for automobiles, is very important. It is unnecessary to say that recourse may always be had to the water jacket, but the circulation obtained in this way necessitates a certain supply of liquid, which represents weight, and especially the setting in operation of a pump that uselessly absorbs a high power. The combination just described seems to be capable of solving the problem very simply, and, for lowering the temperature, utilizes air alone—a fluid found constantly and gratuitously along the route.—La Nature.

THE PAINTING OF MACHINERY.

THERE is often great lack of taste dispayed in the painting of machinery. It is too often daubed with the most glaring and ill-contrasted of colors, which offend the sight and mar the general appearance of the machine. The following remarks, given in The Oil and Colourmen's Journal, ought to help those concerned to a better comprehension of that which they should know, and in the selection of proper artistic contrasts. Machinery has been encountered in which bright, gaudy reds and scarlets mingled with garish blues and yellows in the most extraordinary and bewildering manner. A very little consideration will show that such combinations are breaches of the laws of harmony, which require that one color shall be subservient to the other so as perfectly to blend the whole to an even and pleasing tone. Thus the complementaries of red are green; of blue, orange; and of yellow, violet. Precise rules, however, cannot be laid down, and much depends upon artistic effect to be decided by the reasoning eye. The following suggestions as to contrasts, however, may be found of some assistance: (1) Black and warm brown; (2) violet and pale green; (3) violet and light rose color; (4) deep blue and golden brown; (5) chocolate and bright blue; (6) deep red and gray; (7) marone and warm green; (8) deep blue and pink; (9) chocolate and pea-green; (10) Marone and deep blue; (11) claret and buff; (12) black and warm green; (13) slate color, with nearly all bright colors excepting blues; (14) buff and black; (15) buff and blue or mauve.

In connection with this may be appended a few remarks on the preservation of ironwork in machinery, especially of such as are in outdoor use. On the catches, hinges, and other ironmongery of houses, gardens, farms, etc., iron is generally conspicuous in many places by its fine red rust, and this very product, if taken advantage of, affords the means of its own conservation. Nothing is required but a little boiled linseed oil and a small brush or tool, and the mixture of the oil in very small quantities with the rust will make a true paint that will stand well. It is well to apply it in warm, sunny weather, in order that the coating may dry quickly. Our American cousins have a method of at once preserving iron articles, and giving them a bronzed appearance, which is effected thus: The articles to be bronzed are coated with linseed oil, and then made hot in the open air. If their nature prevents them from being submitted to a high temperature, they may be steeped in a slightly acid solution of ferric chloride, plunged in hot water, dried, and finally rubbed with linseed oil or wax. Another mode of preserving iron from rust is to steep it for a few minutes in a solution of sulphate of copper—common blue stone or blue vitriol—and afterward in a solution of hyposulphate of soda, acidulated with hydrochloric acid. The result is a blue-black coating, not affected by air or water.

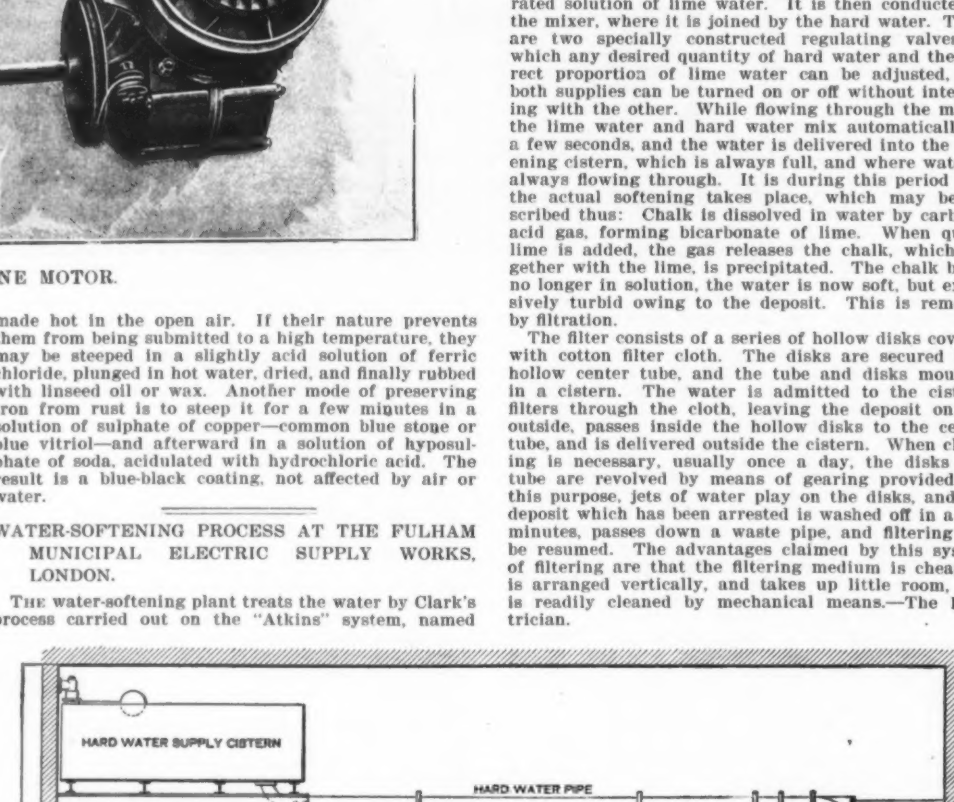
WATER-SOFTENING PROCESS AT THE FULHAM MUNICIPAL ELECTRIC SUPPLY WORKS, LONDON.

THE water-softening plant treats the water by Clark's process carried out on the "Atkins" system, named after the inventor, Mr. W. G. Atkins, whereby a certain quantity of caustic lime is added to the water, mixed with it, run into large tanks, where the chalk is precipitated, and finally filtered. The plant is capable of dealing with 8,000 to 10,000 gallons of water per hour. The guarantee requires that any intelligent workman can operate the plant, and that water with 15 or less degrees of hardness must be softened so that the hardness is reduced to less than one-half grain of carbonate of lime per gallon if required. The plant, whose arrangement is illustrated, consists of the following parts:

1. A lime slaking, straining and storing machine.
2. A cylinder in which lime water is formed.
3. A "mixer," being a shallow trough fitted with baffle plates.
4. A cistern in which the actual softening takes place.
5. A filter.

The method of working is as follows: The lime is delivered directly into a hopper, which forms part of the lime-slaking machine. The machine is set in motion, and in a few hours sufficient lime to last three weeks is automatically reduced to the form of cream of lime, and stored in a mill under the hopper. This mill is fitted with stirring arms and a self-cleaning strainer; about once a day the cream of lime is stirred, and a certain quantity pumped into the lime water cylinder. A jet of water is admitted at the bottom of this cylinder, and passes out at the top as a saturated solution of lime water. It is then conducted to the mixer, where it is joined by the hard water. There are two specially constructed regulating valves by which any desired quantity of hard water and the correct proportion of lime water can be adjusted, and both supplies can be turned on or off without interfering with the other. While flowing through the mixer, the lime water and hard water mix automatically in a few seconds, and the water is delivered into the softening cistern, which is always full, and where water is always flowing through. It is during this period that the actual softening takes place, which may be described thus: Chalk is dissolved in water by carbonic acid gas, forming bicarbonate of lime. When quicklime is added, the gas releases the chalk, which, together with the lime, is precipitated. The chalk being no longer in solution, the water is now soft, but excessively turbid owing to the deposit. This is removed by filtration.

The filter consists of a series of hollow disks covered with cotton filter cloth. The disks are secured to a hollow center tube, and the tube and disks mounted in a cistern. The water is admitted to the cistern, filters through the cloth, leaving the deposit on the outside, passes inside the hollow disks to the center tube, and is delivered outside the cistern. When cleaning is necessary, usually once a day, the disks and tube are revolved by means of gearing provided for this purpose, jets of water play on the disks, and the deposit which has been arrested is washed off in a few minutes, passes down a waste pipe, and filtering can be resumed. The advantages claimed by this system of filtering are that the filtering medium is cheap, it is arranged vertically, and takes up little room, and is readily cleaned by mechanical means.—The Electrician.

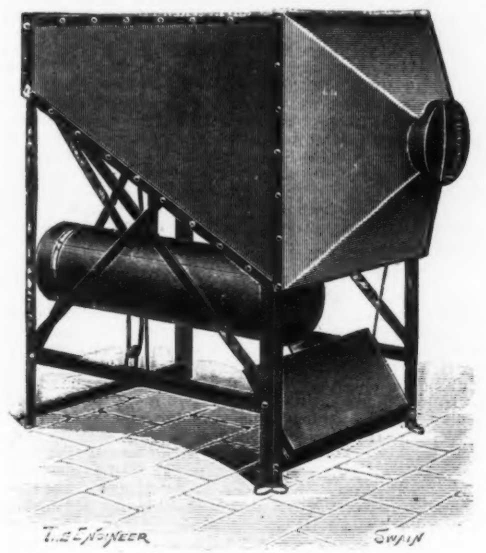


GENERAL ARRANGEMENT OF WATER-SOFTENING PLANT—PLAN AND ELEVATION.

PORTABLE FORGE.

THE illustrations given herewith represent a light portable forge particularly adapted for colonial uses, which has been designed by Mr. John Bauer, Elm Bank Gardens, Barnes. Unlike bellows forges, it is not injuriously affected by tropical heat, excessive cold, or moisture. The draught is produced by an 8-inch fan operated by a single treadle motion. The hearth and fire pan are made of asbestos—specially treated to resist wear and tear—and other light material, which is a bad conductor. In the design attention has been paid to the economizing of space, and with this object in view, the hood is constructed so that it can be folded down to inclose and protect the forge when not in use. The construction of the forge is such that in case of breakage of any part it can easily be repaired with material obtainable in almost any situation at small cost and with little delay. Adjustable brackets are provided, by which bars, tubes, or tools may be supported in any desired position while being heated. A further advantage claimed for the forge is that in case any bits of fuel should find their way into the fan they can readily be removed by taking off the fan.—Engineer.

BAUER FORGE OPEN.



BAUER FORGE CLOSED.

HORO-KILOMETRIC METER FOR CARRIAGES.

THE apparatus represented in the accompanying engraving, and called by its inventor a "taxameter," is designed for registering the length of the trip made by a public carriage, as well as the time consumed in effecting it. Through an ingenious combination, it indicates also the fare to be paid, the additional charges, if there be any, and the rate chosen.

When the carriage is in motion, the taxameter is actuated by one of the wheels, but during stops, waits, or slow movement, a clockwork mechanism keeps it going. The working parts are inclosed in a metallic box and perfectly protected from dampness and dust, and are accessible only to persons who are authorized to examine them. The mode of control is readily adjusted to the different forms of carriages, while the transmission may be mechanical or pneumatic.

Motion is transmitted to the apparatus by means of a compensating ratchet contained in a small box under the taxameter, and the mechanical or pneumatic connection is made from the wheel to this box so that the taxameter always remains completely independent of the periphery of the wheels and becomes interchangeable. Both the taxameter and this box are provided with an ineffaceable factory number, and are mounted in a vertical position on a common base.

The taxameter indicates, on the left side, the fare in francs and centimes; underneath, the extra charges; and to the right, the rate to be applied. All the passenger has to do is to see whether the rate applied agrees with the printed one hung up in the carriage. In any event, the passenger cannot be charged a sum greater than that indicated upon the dial in the compartment, "*Prix a payer*" ("fare to be paid") and "*Supplements*" ("extras"). The action exerted by the rate mechanism upon the indicator movement causes the latter to advance more rapidly in proportion as the rate employed is higher. A change in rate influences the "total charge" mechanism only when the carriage is in motion, so that the higher fare indicated when a higher rate is in use is strictly a remuneration for the actual harder service necessitated by the conveyance of several persons. The faster the carriage is run and the quicker it takes its passenger to the end of his trip, the quicker the driver gets his money; and inversely, as the fare is determined only by the kilometric distance, it remains the same in both cases.

While the carriage is running slowly, either at the request of its occupant or because of an upgrade, or during the stoppage of the carriage, the clockwork movement intervenes and maintains the fare according to the determined rate.

The manipulation of the apparatus by the operator of the vehicle is effected by means of a strong handle placed in the rear of the meter and turned toward the seat. This handle is operatively connected with a signal placed at the side of the meter and visible from a distance. This signal is formed of a red flag bearing in white letters the word "*libre*" ("free"). The mechanical combination of two parts renders it impossible for the coachman to put the apparatus out of service without having previously raised the flag indicating "*libre.*" So, too, it is impossible for him to put the meter in service without having previously lowered the flag.

A button placed alongside of the handle and revolving in the same direction permits of marking the extra charges occasioned by luggage, etc., or a trip beyond the limits. Such extras can be marked only while the meter is in service. In addition to the indications of the fare and extras to be paid, the dial carries four indicators for the owner of the vehicle. These indicators sum up the daily receipts of the operator, the extras, the trips made, and the number of kilometers traversed during the day. The moment the taxameter is set it registers the "right of possession" of the vehicle, which is always the same, and then adds to this sum 10 centimes ($0.025) at a time, as the vehicle progresses. The result of this arrangement is that for short trips a considerably lower price is charged than a driver would ordinarily ask. In the case of long trips the difference is not so perceptible.

The taxameter, which is placed under the eyes of the passenger, consists essentially of a series of transmissions which are actuated in the following manner: When the carriage is in motion, an air pump, at every revolution of the hind wheel, moves, by means of puffs of air on a diaphragm, a lever which causes to advance one tooth a cogwheel, of which the circumference and number of teeth correspond to the hind wheels of the carriage. This wheel, through a train of reduction gearing, actuates a fork mounted externally upon the same base as the taxameter. A transverse pin of the latter, situated in its lower part, engages this fork. This pin is mounted upon an axis which, through gearings, controls an endless screw that actuates the wheel which indicates the trips. This wheel controls another one placed upon the same axle, the teeth of which cause a rocking lever to ascend and descend. It is this latter that, through the intermedium of bevel wheels, actuates the decimes wheel, which it causes to advance one tooth at a time, marking 0.10 franc at every stretch of 400 meters. Upon the axle of the trip wheel is also mounted the hour wheel, which is driven by clockwork. These two wheels are loose upon their shaft, and between them is mounted a ratchet, the teeth of which engage the trip and hour bevel wheels. One of these two wheels will, according to the conditions, travel faster than the other, thus acting as the propelling wheel and setting in motion the rest of the system dependent upon it. When the vehicle is going fast the escapement wheel of the clockwork movement is arrested by a brake; but when the pace is greatly slackened it is that one of the two control wheels which revolves the quickest that will influence the price. If the carriage is stopped the clockwork movement alone will control.

The concurrence of the trip control wheel, when the carriage is proceeding slowly, is necessary in order that the operator may not, to the prejudice of the owner, grant a lower fare to his passenger, and, by a rapid run, make up for a stipulated fare greater than that which the apparatus would register if regulated by time alone.

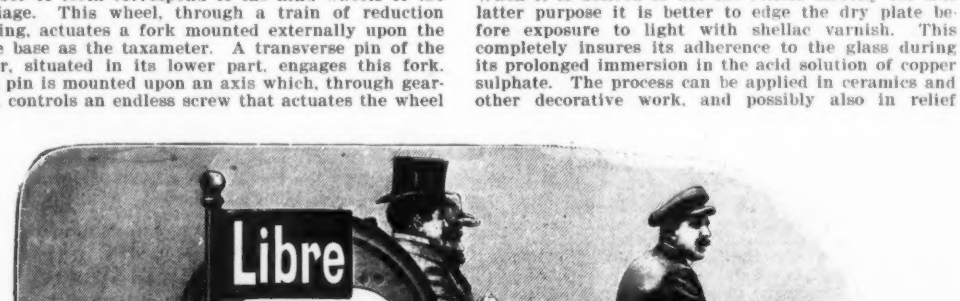
When the apparatus is at rest the hour movement is naturally arrested. If in such position the operator desired to make a trip the apparatus would register the fare during the run. If the coachman waited for his passenger he would do so for nothing. It is therefore of interest for him to place the apparatus upon "*libre*" ("free") as soon as he has finished the trip and received his money.—For the engraving and above particulars we are indebted to La Nature.

GELATINE RELIEFS.

IN order to obtain high reliefs on a film of bichromated-gelatine, Prof. Namais devised the following process, particulars of which were given by him before the International Congress of Chemistry at Paris: The introduction of gum arabic into the sensitive mixture makes it possible to obtain a much higher relief than can be done with gelatine alone. A suitable formula is:

Gelatine	90 gr.	200 gm.
Gum arabic	45 gr.	100 gm.
Water	1 oz.	1,000 c.c.
Acetic acid	4 minims.	10 c c.

The acetic acid is added to preserve the solution. For use, the mixture is rendered liquid in a salt bath, and leveled glass plates coated with it so as to obtain a film of 2 to 3 mm. (0.08 to 0.12 inch) thick. A 3 per cent solution of ammonium bichromate (to which enough ammonia is added to convert the salt into chromate) is used for sensitizing. Although the exposure required is longer than when bichromate is present, the films keep longer—for ten days and longer. Also a higher relief is obtained. No fears of the gum dissolving during sensitizing need be entertained. Exposure under a negative goes on for a quarter or half an hour in the sun, the frame being placed as nearly as possible at right angles to the rays. Now comes the production of this relief. By simple immersion in water the gum will swell irregularly everywhere. Some other means must be used, therefore, to make successful use of the gum. If a solution of alum (2 per cent) be used in place of water (or, better, a solution of alum containing 2 per cent of acetic acid), the gum and gelatine are not prevented from swelling in the usual manner, but solution of the gum—which is probably the cause of the difficulties experienced in swelling with water—does not take place. After several hours' immersion a very great and perfect relief is obtained. The film is very tough, insomuch that it can be used not only for making plaster casts, but for preparing electrotypes. When it is desired to use the reliefs directly for this latter purpose it is better to edge the dry plate before exposure to light with shellac varnish. This completely insures its adherence to the glass during its prolonged immersion in the acid solution of copper sulphate. The process can be applied in ceramics and other decorative work, and possibly also in relief



GENERAL VIEW OF THE HORO-KILOMETRIC METER.

blocks; the relief obtainable by the process is much greater than that given by zinc-etching.—The Process Photogram.

A GENERAL SURVEY OF FOREIGN TRADE.*

Nothing could well be more gratifying than the picture of our foreign trade as it is to-day by comparison with the figures of very recent years. It is all the more remarkable because our progress has been achieved with but little effort and by means not directed specifically to the promotion of foreign trade, but largely fortuitous, and springing from our intense absorption, for many years, in domestic industry and internal development. In other words, we have reached a surprising eminence in the exportation of manufactured goods, not because we were seeking that goal, but because, in developing our resources, in manufacturing for the home market, we attained an excellence and comparative cheapness of production which, to the astonishment of ourselves as well as of the world at large, has suddenly made us a formidable competitor—perhaps the most formidable of all—in the great international rivalry for trade.

The question for the future is whether we can permanently hold the position we seem about to gain, by means of what may be termed our purely domestic advantages of economy of production, greater labor efficiency, and cheap raw materials, or whether we shall not have to fight hard against nations now falling behind us, with weapons specially fashioned for controlling foreign trade—as, for example, more scientific export methods, better facilities of banking and transportation, more liberal credits, and manufacturing for particular markets with intelligent regard to climatic and race requirements. Many of our consuls still tell us that our commercial activity abroad is almost primitive in the details of trade competition, although of late our exporters have begun to send capable representatives to the more important trade centers; and the past few years have witnessed the creation of important trade organizations in the United States for the study of foreign commerce, the adoption of special courses of commerce at a number of our colleges, and the establishment of sample rooms and agencies for the sale of American goods at a few of the entrepôts of countries which offer a favorable field. Meanwhile, foreign manufacturers are introducing our labor-saving machinery or imitating it, and European economists are urging industrial reforms or legislative enactments to meet our threatening competition.

GROWTH OF MANUFACTURED EXPORTS.

During the year ended December 31, 1900, according to United States Treasury returns, the imports of the United States amounted in round numbers to $830,000,000, an increase of over $30,000,000 compared with 1899, while the exports aggregated $1,478,000,000, an increase of $202,480,000. The exports in 1900 exceeded the imports by $648,900,000. Of the exports, the percentage of manufactured goods rose to 31.54† for 1900, against 30.39 in 1899, 24.96 in 1898, and 24.93 in 1895. Of the imports, nearly 45 per cent, it is estimated by the Treasury, were materials, either crude or partly made up, for use in our manufacturing industries, an increase of over 35 per cent in 1899 and 1900, as compared with the entire period from 1890 to 1898. In other words, our industrial growth continued in 1900 at a rapid pace, enabling us to take less finished goods from other countries and to furnish more.

PREDOMINANCE IN IRON AND STEEL.

The most striking fact in our export development is the remarkable growth of the foreign demand for our iron and steel, our exports amounting to nearly $130,000,000 in 1900, against $32,000,000 in 1895.

CHEAPNESS OF AMERICAN GOODS.

It is the relative cheapness of American steel that has given it pre-eminence, and it is the same with other products that are winning their way abroad. Economy of production is the master key that unlocks for us markets that seemed a little while ago to be inexorably closed. This economy of production implies not merely low prices to the foreign consumer, but a greater degree of excellence, a superior adaptation to his wants. As has been pointed out in the reviews, as well as elsewhere, the American workingman, though receiving higher wages, produces, with labor-saving machinery, at a lower unit of cost, and his greater application and ingenuity enable him to avail himself effectively of the most recent inventions and appliances for improving the quality of his special line of work. The American factory system is highly organized and more efficient than any other, and, if our export trade were as well developed, there would be little to fear. The only lesson our manufacturers need to learn, it would seem, is the necessity of manufacturing especially for foreign trade; and the great increase of requests for information from our consuls as to the kinds of goods wanted in particular markets, and also of manufacturing processes employed in this or that line of industry, encourages the hope that there is beginning to be a general perception of this important fact.

CONCENTRATION OF CAPITAL IN THE UNITED STATES.

Lord Rosebery is quoted by cable as having said in a speech before a British chamber of commerce January 16, 1901, that the chief rivals to be feared by Great Britain "are America and Germany."

It has been evident for some time that the United States, not content with having solved that part of the problem of economy of production which relates to processes of manufacture and the utilization of labor, has been drifting instinctively toward the larger question of the concentration of capital as the logical development of the same general idea of reducing cost and increasing the margin of profit. The question is larger because it has a more direct and more general bearing upon the economic and social life of the nation, upon the interests, real or imagined, of the whole body politic. We have to do with it here only because of its relation to and possible effect upon our foreign trade, and it is interesting to know that so thoughtful an observer as Lord Rosebery perceives in the simplification of the use of capital in the United States which is going on—it may be said experimentally, to a large extent as yet—a tremendous power in the commercial rivalry of the world.

GERMAN VIEWS OF AMERICAN COMPETITION.

Germany, as well as Great Britain, seems fully sensible of the seriousness of American competition. In a recent issue, the Hamburger Fremdenblatt points out that the United States, which ten years ago exported more than 80 per cent of agricultural products and less than a fifth of manufactured goods, to-day draws nearly a third of its entire exports from the products of its factories. "In other words, the Union is marching with gigantic strides toward conversion from an agricultural to an industrial nation."

The Fremdenblatt's conclusion is that Europe "must fight Americanism with its own methods; the battle must be fought with their weapons, and wherever possible their weapons must be bettered and improved by us. Or, to speak with other and more practical words, Germany—Europe—must adopt improved and progressive methods in every department of industry; must use more, and more effective, machinery. Manufacturers as well as merchants must go to America, send thither their assistants and workingmen, not merely to superficially observe the methods there employed, but to study them thoroughly, to adopt them, and wherever possible to improve upon them, just as the Americans have done and are still doing in Europe."

SERVICES OF UNITED STATES CONSULS.

Dr. Vosberg-Rekow, head of the German bureau for the preparation of commercial treaties, attributes the remarkable growth of exports of American manufactures to Europe, in part, to the activity of our consular service. "The United States," he says, "has covered Europe with a network of consulates and makes its consuls at the same time inspectors of our exports and vigilant sentinels, who spy out every trade opening or advantage and promptly report it." Dr. Vosberg-Rekow also dwells upon the eminently practical character of American industrial and business methods. "Germany's industrial advancement," he says, "is principally due to the thoroughness of her technical education. It is strengthened by the continuous substituting of machinery and machine tools for hand labor. Still, in this respect, the English industry in some branches is ahead of us. It is worthy of note that in this evolution, too, the United States has the foremost place and has made gigantic strides, not only in applying machine tools, but in inventing and manufacturing them, so that to-day she supplies us. This signalizes in an extraordinary degree American intelligence. Thus, the Americans, though wanting our superior technical education, thanks to their practical eye improve upon our methods and apparatus. Theirs is rather the activity of an experimentalist than that of a trained craftsman; but a clever faiseur, if he but have assurance and luck, may distance the educated master. The Americans have no thorough education; nor do they possess a modern industrial system as we Europeans understand the term. The American applies himself to a single branch or to a specialty, with utter disregard of European methods and their results; he devotes to his work an amount of energy which stupefies Europeans; and, for awhile, he succeeds in driving us out of the line of articles on which he has centered his energy. Against such peculiar activity a general trade policy is quite ineffectual; we must put ourselves in condition to counteract this artificially forced growth of specialized industry."

EDUCATION IN BUSINESS.

Thus we find that expert opinion in Great Britain and Germany coincides in the conclusion that Americans, too eager to be up and doing to apply themselves to preparatory study or to what may be termed a general scheme of education and culture for industry and trade, have, nevertheless, worked out in practice a degree of actual efficiency, not learned from books, which gives them a distinct advantage. It is not to be denied, upon the other hand, that technical schools and special courses of commercial education might greatly enhance our capabilities, if care were taken to prevent them from usurping too far the practical business or industrial training which seems to be the secret of our success thus far. In the more and more strenuous competition which is evidently waiting us, our manufacturers, exporters, and trade representatives abroad will need to be provided with a variety of information which can not be acquired except by academic instruction. The knowledge gained in the workshop or the counting house will not suffice to meet a rivalry which is seeking to equip itself, so far as it can, with our machinery, our industrial and trade methods—with everything, in short, that now gives us supremacy—and will add to these the mastery of details of trade conditions and industrial processes throughout the world, which we are only beginning to study.

FINANCIAL INDEPENDENCE OF THE UNITED STATES.

There is another feature of American influence in the world's markets which is, perhaps, even more notable than our industrial progress, and that is our suddenly acquired financial independence. The Hamburger Fremdenblatt article previously quoted from points out that it is the logical result of our growth in industry and trade and especially of our successful competition in foreign markets. As soon as American industries, through various causes, found themselves in a favorable financial condition, "they likewise undertook the task of freeing themselves from foreign capital—in other words, of reclaiming the industrial securities which were in European hands." "The change in the condition of the United States," adds the Fremdenblatt, "can best be characterized by the statement that the industries, trade, agriculture, railroads, and finances of the Union each and all climbed, one upon another, through and by each other, steadily upward. And to what a height have they climbed!"

During the past year, the point was reached where the United States became a lender of money to other countries instead of a borrower from them.

THE FUTURE OF INTERNATIONAL COMPETITION.

Summed up, therefore, the general conclusion of competent foreign authorities, as well as of our own, is that the commercial expansion of the United States is no longer problematical, but a fact of constantly enlarging proportions which opens up new vistas in the struggle for ascendancy among the industrial powers. Prolific as it has been of great surprises, it is doubtful whether similar phenomena will spring from its undemonstrated forces. It would seem, now that the causes of our unlooked-for triumphs are known and are being carefully weighed and studied, that the future will be one of fruition, of the gradual maturing of our powers, rather than of sudden blossoming of some novel capacity of competition. The day, perhaps, is not distant when the more intelligent of our rivals will be able to meet us upon more nearly equal terms and when, as has already been indicated, it will be necessary to supplement our natural advantages and our highly developed industrial efficiency with the appliances of education, of special training, of technical skill, of more scientific methods of extending trade, which have already secured rich returns—to Germany, for example—in quarters of the globe where our goods, as yet, have made but little if any headway.

RECIPROCAL TRADE AGREEMENTS.

Among the measures which have already forced themselves upon our attention as necessary aids to our expanding commerce are reciprocal trade agreements and better facilities of transportation and banking. Substantial progress has been made in securing the first of these.

TRANSPORTATION FACILITIES AND TRADE.

It would seem to be evident that trade agreements widening the channels of exchange between the United States and other countries must have an important bearing upon the question of building up a merchant marine. One of the great obstacles to the establishment of direct steamship lines from United States ports is the difficulty of obtaining return cargoes. Of course, this operates to the disadvantage of foreign lines engaged in carrying our trade, as well as a deterrent to the investment of American capital in transportation enterprises; but provision for securing a larger volume of freights both ways would seem to be an absolute prerequisite of a healthful revival of our shipping. It is a fact of great significance that wherever better facilities of transportation have been provided our foreign commerce has immediately grown, even in the face of obstacles that might have seemed insurmountable and in the absence of other measures for promoting trade. In view of the constantly spreading popularity of American goods, the element of hazard or speculative enterprise in seeking to open up a particular market would seem to have been reduced to a minimum. If we can compete successfully with European manufacturers in their home markets, we need not fear that the foreign markets which they supply will, under natural conditions, be slow in taking our superior products. The only barrier to their introduction will be the artificial one of tariff or other discriminating legislation, and this may be either removed or greatly modified by a judicious scheme of reciprocity. If to such agreements, securing favorable treatment of our exports, we add concessions permitting the importation of a larger volume of foreign products, we lay at once the basis for such exchange as may justify the establishment of direct transportation lines. In this view of the matter, our tariff concessions—framed with a careful regard for the protection of our home industries—are seen to involve substantial benefit to ourselves as well as to foreign producers, in the promise they hold out of acting as an incentive to the investment of American capital in the carrying trade as well as in the enlargement of our export of goods.

Conspicuous illustrations of the benefit of direct transportation and of the fact that increased trade follows its establishment are found in the recent growth in the export of American products to such unlikely quarters as Turkey and Peru. Some two years ago, our consul-general at Constantinople, Mr. Dickinson, exerted himself to secure the running of a direct line of steamers between the United States and Turkish ports on the Mediterranean. The Barber Line of New York decided to make the experiment, and the service, begun in February, 1899, has greatly stimulated the sale of American products in the Levant. Under date of April 14, 1900, Mr. Dickinson states that "since the establishment of the direct line and the consequent reduction of freights, wire nails and a few other articles of American manufacture appear to have taken possession of the Levantine markets." The next step taken by Mr. Dickinson, and one that was made possible by the improved transportation facilities, was the establishment by private capital of an exposition of American goods and agency, which, he says, "is already [November 15, 1900] a success and has outgrown the expectations of those who are conducting the business."

Peru increased her commerce with this country from $1,588,000 in 1897 to $3,491,000 in 1899, and during eleven months of 1900 our exports to Peru amounted to nearly $2,000,000, against something over $600,000 in 1893. Our consul at Callao, Mr. Dickey, attributes this gain in part, at least, to better transportation facilities offered by two steamship lines which, for the past three years, have kept up a monthly service between New York and the west coast of South America. There has been much speculation as to the cause of the slowness of the growth of our trade with South America, and although several powerful influences may be adduced—as, for example, the greater activity of European exporters, the control of banking facilities by European capital and its large investments in South American enterprises, the influence of European immigration, and the special manufacture and packing of goods to meet the local requirements—it would appear that trade is awaiting us there, as well as else-

* Extract from the Review of the World's Commerce, introductory to Commercial Relations of the United States, 1900 (in press). By Frederic Emory, Chief Bureau of Foreign Commerce. Maps will be published in our next issue illustrating the article.

† Later returns give the percentage as 30.38. This decline is attributed to the increase in the proportion of agricultural exports at the end of the year; also to the decrease in exports of copper ingots and cotton cloths, the latter mainly to the Chinese Empire.

where, if we provide it with easy and convenient channels.

This conclusion is emphasized when, coming nearer home, we find that our commerce has obtained a strong footing in regions which are not only closer to us, but have the speediest and most efficient means of communication—as Mexico, the West Indies, Central America, the north coast of South America. The same thing will probably be found to be true of our Pacific coast trade. Enlarged transportation facilities undoubtedly account, to a considerable extent, for the steady growth of our commerce with Japan. The improvement of the means of communication between California and the west coast of Central and South America by the establishment of the German line of steamers running south from San Diego has caused a reduction of freights and will undoubtedly augment the sale of our goods.

It is not to be expected that capital will invest in steamship lines or in other transportation enterprises unless it perceives a reasonable prospect of profit, but the history of railroad development in the United States sufficiently proves that capital is far from being timid in anticipating the possibilities of trade in a naturally productive territory which only awaits the means of reaching a market. What has happened on land may not happen on the sea; but, in view of our altered relations, industrial and commercial, to the rest of the world and our proven efficiency in supplying its needs, may it not be found that the sea—so long a barren waste to us—has become at last a fertile field for the same kind of enterprise which has given us an unexcelled system of internal and coastwise transportation?

GENERAL SUMMARY OF TRADE.

When we come to survey the field of international competition, as described by our consuls and in the light of comments by foreign economists and trade authorities, we find some highly significant indications of the probable course of trade currents within the next few years. As to the general march of our commercial expansion in the immediate future, the reports of the consuls emphasize the conclusions to be drawn from the most recent figures of the United States Treasury. According to a statement issued by the Bureau of Statistics of that Department for the decade ended with the calendar year 1900, our imports, which in 1890 were $823,397,726, were in 1900 $829,052,116, an increase of less than 1 per cent in the decade; while our exports, which in 1890 were $857,502,548, were in 1900 $1,478,050,854, an increase of 72.4 per cent. In 1890, the excess of exports over imports was $5,654,390; in 1900, it was $648,998,738.

"In our trade relations with the various parts of the world," continues this statement, "the change is equally striking. From Europe, we have reduced our imports in the decade from $474,000,000 to $439,000,000, while in the same time we have increased our exports from $682,000,000 to $1,111,000,000. From North America, imports fell from $151,000,000 in 1890 to $131,000,000 in 1900, while our exports to North America increased during that time from $95,000,000 to $202,000,000. From South America, the imports increased from $101,000,000 in 1890 to $102,000,000 in 1900, while to South America our exports increased from $35,000,000 to $41,000,000. From Asia, the imports into the United States increased from $69,000,000 in 1890 to $123,000,000 in 1900, while to Asia our exports in the same time increased from $23,000,000 to $61,000,000. From Oceania, the importations in 1890 were $23,000,000 and in 1900, $23,000,000, while to Oceania our exports in 1890 were $17,000,000 and in 1900, $40,000,000. From Africa, importations increased from $3,000,000 in 1890 to $9,000,000 in 1900, and exportations to Africa increased from $4,500,000 in 1890 to $22,000,000 in 1900."

The changes in the movements to and from the continents are attributed by the Bureau of Statistics to two great causes: First, the increase at home of manufactures which were formerly drawn chiefly from abroad; and, second, the diversification of products, by which markets are made for many articles which formerly were produced or exported in but small quantities. "From Europe, to which we are accustomed to look for manufactures, our imports have fallen over $35,000,000, while Europe has largely increased her consumption of our cotton-seed oil, oleomargarine, paraffin, manufactures of iron and steel, copper, and agricultural machinery, as well as foodstuffs and cotton, our exports to that grand division having increased $428,000,000 since 1890. From North America, the imports have fallen $20,000,000, due chiefly to the falling off of sugar production in the West Indies, the imports from Cuba alone having decreased from $54,000,000 in 1890 to $27,000,000 in 1900. To North America, the exports have increased meantime over $100,000,000, the growth being largely manufactures and foodstuffs, a considerable portion of the latter being presumably re-exported thence to Europe. From South America, the imports have increased in quantity, especially in coffee and rubber, but decreased proportionately in price, so that the total increase in value in the decade is but $1,000,000, while in exports the increase is $6,500,000, chiefly in manufactures. From Asia, the importations have increased more than $50,000,000, the increase being chiefly in sugar and raw materials required by our manufacturers, such as silk, hemp, jute, and tin; while to Asia the increase in our exports has been nearly $40,000,000, principally in manufactures and raw cotton. From Oceania, the imports show little increase, though this is due in part to the absence of statistics of importation from Hawaii in the last half of the year 1900; while to Oceania, there is an increase in our exports of more than $20,000,000, chiefly in manufactured articles. From Africa, the increase in imports is $6,000,000, principally in manufacturers' materials, of which raw cotton forms the most important item; while our exports to Africa increased meantime $17,000,000, chiefly in manufactures."

The following table shows the imports and exports of the United States by grand divisions in the calendar years 1890 and 1900. In the figures showing the distribution by continents in 1900, the December distribution is estimated, though the grand total of imports and exports for 1900 is based upon the complete figures of the Bureau of Statistics.

Grand Divisions.	Exports from United States.		Imports into United States.	
	1890.	1900.	1890.	1900.
Europe	$682,585,856	$1,111,456,000	$474,656,257	$439,500,000
North America	95,517,863	202,486,000	151,490,390	131,200,000
South America	34,722,122	41,384,000	100,959,799	102,000,000
Asia........	22,854,028	60,598,000	68,340,300	122,800,000
Oceania.....	17,375,745	39,956,000	23,781,018	23,400,000
Africa.....	4,446,934	22,170,000	3,160,066	9,900,000

NEW CURRENTS OF TRADE.

Besides the surprising development of our sales of manufactured goods in the most advanced industrial countries of Europe, which may be said to have introduced an entirely new element into Old World trade, we find other phases of commercial expansion which were quite as unexpected and are likely to profoundly affect our economic, and perhaps our political, future. The rapid growth of cotton manufacturing in our Southern States, for example, could not have been anticipated a few years ago, although it seemed probable to those familiar with the peculiar advantages of the South for engaging in this industry that some day that section would emerge from its position of dependence upon outside markets for the consumption of its cotton and create its own home markets by the erection of mills. Within the years 1889-1899, inclusive, according to Mr. A. B. Shepperson, of New York, the number of spindles in the South increased 190½ per cent against 11.4 in our Northern States, 4 1-3 per cent in Great Britain, 30.6 per cent in continental Europe, 71 per cent in India. "In the percentage of increase of spindles and of consumption of cotton" (206½ per cent in Southern and 29 per cent in Northern mills), says Mr. Shepperson, "the South makes the best showing of the countries compared, while India is a good second."

There are now nearly 4,000,000 spindles in the South, against 1,360,000 in 1889, and new mills are constantly being built, although the past year has witnessed depression in the industry due to the troubles in China. The entrance of the South into oriental trade is almost as novel a feature of our expansion as any that have been indicated, and it is one that seems likely to have a most important bearing upon our social and political evolution, as well as upon our influence in international trade. The South has suddenly acquired a great stake in the affairs of the Far East, and what this may mean in the adjustment of our relations with other countries having large interests there and in shaping our international politics is a question which only the future can answer. In a memorial from the cotton manufacturers of the South addressed to the Secretary of State in November last, commending the "open-door" policy in China, the statement is made that a large part of the production of the cotton drills and sheetings manufactured in Southern mills is exported to North China, and that "the prohibition or interference in China by any European government would tend to seriously injure, not only the cotton-manufacturing industries, but other important products of the United States which are being shipped to China. For the protection and perpetuity of these commercial relations," it is added, "we earnestly pray that the Administration will take such action as may be proper under existing conditions. It is not only the manufacturers of cotton goods that would be seriously affected, but the Southern planter and cotton grower, who finds a ready cash sale for his products at his very door; and also the thousands of employes and laboring classes who are engaged in the cotton mills and depend on the success of these manufacturing industries for a livelihood."

The developments of the past two years in consequence of our acquisition of the Hawaiian and Philippine islands have brought another factor into prominence in our commercial development, which may be potential of unlooked-for results. The Pacific slope is rapidly being converted from a mere outpost of trade into a great hive of commerce. Not only San Francisco, but Port Townsend, Seattle, Tacoma, and Portland are becoming entrepôts of oriental and South Pacific commerce, and San Diego seems likely to be an important factor in the development of trade with the west coast of Latin America.

The growth of sea-borne commerce at these points means much for the great extent of country tributary to them and promises to work marked changes in the industrial condition of the vast region west of the Rocky Mountains. In a similar way, our Southern group of States may find a sweeping readjustment of their economic relation to the rest of the Union in the fact that Cuba and Porto Rico now offer them easy and convenient stepping stones to Latin American trade.

Even in the now familiar conditions affecting the Atlantic seaboard, which, as we have seen, have recently produced a great increase in our export trade, a new element appears in the statement of our consul in Sierra Leone, Mr. Williams, that, in a few years, West Africa will offer a market for our goods "only second in importance to that of China." East Africa and South Africa have already shown a marked preference for certain lines of American manufactures, but West Africa is for our exporters a new and more accessible market, the possibilities of which have heretofore attracted but little attention.

(To be continued.)

SOLDERING ALUMINIUM.

Upon attempting, with any ordinary solder, to join sheets of the metal, it is noticeable that the mixture does not take hold, but tends rather to run off, or perhaps it will chill, utterly refusing to tin the sheets, and rarely adhering to the aluminium. The reason of this behavior is that there is always present a thin continuous coating of oxide, which effectually prevents the solder from getting to the true metal beneath. This thin, almost invisible, skin of alumina, or oxide of the metal, is of instantaneous formation, and the surface of the metal may be scraped or filed without even temporary relief because of the immediate renewal of the coating.

The uses of fluxes and acids to overcome this difficulty have been repeatedly suggested without securing satisfactory results, and a new theory tending toward the solution of the problem must needs be approved. Dr. Joseph W. Richards of Lehigh University, Bethlehem, Pa., U. S. A., conceived the successful practice of overcoming the difficulty by incorporating into the composition of the solder an ingredient that would remove the oxide film during the process of soldering, thereby preserving the surfaces clean until the union of the parts had been accomplished. The solder devised and patented by Dr. Richards carries in its make-up an alloyed flux of phosphorus in tin, the theoretical necessity of the simultaneous action of the flux and the taking hold by the solder being confirmed during many years by the satisfactory results obtained in actual commercial practice.

The high heat conductivity of aluminium is another characteristic of this strange metal, and the refusal of many solders to perform their expected duty is traceable to it. The aluminium quickly and readily absorbs the heat from the soldering iron, and the temperature of the tool is thus so far reduced that the solder "freezes" at the joint and failure ensues. To overcome this difficulty, which arises in large work particularly, it is necessary to keep the soldering-iron very hot, and oftentimes it tends to the betterment of the result to apply heat likewise to the parts to be joined.—Joseph A. Steinmetz, in Cassier's Magazine for March.

ON CERIUM.

By W. Marckwald.

The often repeated statements in present day literature, that cerium consists of at least two elements, have led me to publish herewith a research undertaken by me some time ago with the intention of finally deciding this important question. In this case, as in many other paths, laboratory experiments are superseded by technical methods of working; I will therefore describe the course I adopted, instead of merely stating the results obtained. I started with raw commercial cerium carbonate (50s. per 100 kg.), of which 250 kg., mixed into a paste with water (to avoid frothing over), were dissolved in a just sufficient quantity of raw hydrochloric acid. The heavy metals present were then precipitated by addition of potassium sulphide solution, and from the clear decanted solution in large wooden vessels the cerium was partially precipitated by means of alkaline chloride of lime solution (90 per cent of the required chloride of lime). The deep yellow precipitate was pressed and washed. By going carefully to work this product now contains but little didymium, but relatively much (more than 2 per cent) lanthanum and yttrium. By washing with dilute nitric acid, part of the didymium, etc., was removed. By dissolving in concentrated nitric acid, cerium nitrate is obtained (with evolution of chlorine), from which solution ceriammonium nitrate could be almost quantitatively produced by neutralizing with ammonium nitrate. But as the two ceriammonium nitrates crystallize with equal facility, and do not dissociate upon addition of foreign substances, the total solid after being pressed was mixed with hot oxalic acid solution and a little hydrochloric acid, whereupon it is quickly converted into heavy oxalate (with evolution of carbonic acid), from which the remaining impurities, iron, calcium, etc., can be easily removed by washing. The oxalate was treated with great excess of soda and the washed carbonate dissolved in nitric acid. The completely colorless solution still distinctly showed the absorption bands of didymium in thick films; but not by observation in the eprouvette. This proves that a strongly dispersing system of prisms is not suited to the observation of the absorption spectra, because the weak absorption shadows of dilute solutions are easily overlooked, while a direct vision spectroscope shows the absorption bands in the form of deep black lines, with the advantage of being able to see the whole spectrum simultaneously. One quickly learns to identify the spectrum from the general character of the appearance without being obliged to measure laboriously the individual lines.

The nitrate solution, treated with ammonium nitrate and evaporated, yielded the salt $Ce_2(NO_3)_6.xNH_4NO_3$ + Aq. crystallizing in silky shiny needles 20 c.m. long, also the salt $Ce_2(NO_3)_6.3NH_4NO_3.10Aq$, crystallizing in large rhombic plates. (Only the latter served for fractional crystallization.)

Both salts are only slightly hygroscopic, and crystallize very easily by the retention of didymium in the mother-liquor. The yttrium earths and lanthanum remain obstinately attached to the salt, a phenomenon which I have also observed upon re-crystallization of the cerium salt. This double nitrate was now subjected to a systematic fractional crystallization, and in the course of seven months more than two hundred crystallizations were carried out. Widely removed fractions were tested by Auer's basic method, a part converted into the salt of the dioxide and treated with hot water, but all fractions thus obtained were not in the least distinguishable from cerium preparations which could have been obtained with sufficient care according to the older methods. Also the illuminating power of the incandescent bodies prepared from them was the same. At the same time I may mention that none of the fractions gave a pure white cerium dioxide upon heating; the oxide showed instead a pale yellow glow. Again, the means recommended by Wyrouboff and A. Verneuil for purifying cerium salts gave a cerium nitrate, which upon heating left a yellowish oxide, when reducing mediums were kept away (for which a white heat was necessary). According to this method no preparation free from didymium can be obtained. A little didymium is invariably precipitated with the least basic fractions.

As regards lanthanum and the yttrium elements, these were undoubtedly removed after three crystallizations. In working with compounds containing as much as 4 per cent yttrium, erbium, and above all ytterbium, this method is of no use.

For removal of the latter, the freshly precipitated oxalates are dissolved in strong potash solution (soda is less suitable on account of the less solubility of sodium oxalate). In accordance with published accounts, all the elements of the cerium and yttrium groups dissolve readily in concentrated solutions of the alkaline carbonates. If this solution is poured into

a large quantity of hot water, the carbonates of the elements of the cerium group are precipitated, while those of the yttrium group remain in solution. They can be precipitated as oxalates by acidifying or as hydrates by strong potash, and then further purified by conversion into the sodium double sulphate. (It is incomprehensible why hitherto potassium sulphate, which is eight times as dear, has been used for this purpose.) The solubility of the yttrium elements in ammonium carbonate renders it less suitable for the separation. Further, it is necessary by the potassium carbonate method to decant quickly after the disposition of the cerium carbonates if loss is to be avoided. —Berichte der Deutschen Chemischen Gesellschaft, 1901, No. 19.

IN THE LAND OF THE ESKIMO.

THE explorations which of late years have been carried on in the polar regions have not only materially contributed to geographical science, but have added much to our knowledge of the Eskimo.

In Greenland inhabitants are found only on the southern coasts, and are shut in by a high barrier of inland ice. The inhabitable zone which is thus formed has a maximum width of 150 kilometers at Holstensborg, in Danish West Greenland. In some places, particularly on the eastern coast recently explored by Lieut. Andrup, the inland ice reaches to the very coast itself.

For ethnologists the people who live near the east coast and on Smith Sound are of unusual interest; for up to very recent times they never came in contact with other tribes, and have, therefore, retained their primitive customs to this very day. In Danish West Greenland, which extends northward to the 74th degree of latitude, the aborigines have reached a stage of civilization most astonishing in so primitive a people. Aside from the fact that most of the inhabitants are Christians, there is not a single man or woman who cannot read and write. In the colony of Godthaab, a newspaper is even published in the Eskimo language, which is issued exclusively by Eskimos. The editor, the contributors, most of whom are trappers and fishermen who narrate their adventures (for seal hunting in a kaik is adventurous enough), the compositors, the printers—all are Greenland Eskimos. The feminine portion of the population is no less advanced in its ideas. The young Greenland women, in their Sunday attire of blouse, skirt, long pearl necklace reaching to the knees, neatly trimmed and embroidered trousers, and boots of red or blue dyed leather or bleached fur, have aroused the admiration of many a traveler.

The Eskimos on Smith Sound, who live as far north as the 78th parallel, and may for that reason be considered the most northerly of peoples, together with their tribal relatives on the eastern coast, still lead a most primitive, pagan existence. Strong efforts have been made of late to introduce Christianity among them. Denmark has erected a commercial station and a mission at Angmagssalik, which are the permanent seats of a Danish commercial agent and a clergyman. One of the accompanying illustrations pictures the first couples of the heathen population of Eastern Greenland who were married in accordance with the rites of the church. Angmagssalik, which lies between the 65th and 66th degrees of latitude, is now the most northerly inhabited place on the Eastern Greenland coast. In the vicinity of the station some 240 Eskimos have settled, who live in eight winter huts. In each of these Eskimo huts, consisting of but a single living room, several families, comprising in all thirty persons, are sheltered. Eskimos are also to be found in the region extending to the southern point, but their number is not known. The four Eskimo couples which we picture are magnificent types of this old, uncorrupted, primitive people. Whether churchly marriages will tie men and women more firmly together can be determined only in time. For these savages love variety. If an Eskimo sees a pretty girl who pleases him better than his wife, he leaves the woman to whom he has been married, and his wedded life is considered at an end. The reasons for separation are often curious. An Eskimo may leave his better half because she does not keep his boots clean, or because she eats too much. If the home of the Eskimo is not blessed with children, the help of "angekoks" is called into requisition—magicians who are supposed to influence good spirits and to have the power of performing miracles. An "angekok" is fully capable of journeying to the moon and of hurling down a child to an anxious family.

The Eskimos marry early. When an Eskimo girl reaches the age of sixteen years, after having wandered around within the family hut in a paradisical condition with the rest of the inmates, she begins to wear trousers and to tie her hair in a huge roll—the sign that she is of marriageable age. Although sixteen is the age at which girls usually wed, children of thirteen are not infrequently wives.

GREENLAND WOMEN OF THE WESTERN COAST.

The Eskimos who live in the vicinity of Angmagssalik are of medium height and rather slenderly built. The men have long, dark brown hair and sharply-chiseled features. For the most part they are beardless; for the youths usually pull out the hair of the face when it appears. The women often tattoo themselves between the eyebrows, about the nose, on the chin and arms. Many Eskimos have two wives, if they are rich enough to support them. There are very few unmarried women, although men are here in the minority. For a particularly handsome girl an Eskimo must present his father-in-law with some gift—a harpoon or the like. But if he be an industrious man, he receives a marriage portion.—F. Mewius in Illustrirte Zeitung.

INHABITANTS OF GREENLAND'S WESTERN COAST.

THE PROGRESS OF SEISMOLOGY DURING THE NINETEENTH CENTURY.

By CHARLES DAVISON, Sc.D., F.G.S., in Knowledge.

SEISMOLOGY as a science is a product of the latter half of the nineteenth century. Recalling earlier contributions to the subject, that which stands out the most prominently is John Michell's memoir on the cause and phenomena of earthquakes, read before the Royal Society in 1760. It is interesting to notice how Michell anticipates some of the results of later workers. He recognizes, for instance, that the slow-period waves are propagated to far greater distances along the surface than the rapid vibrations which form the perceptible shock, and that the velocity of seismic sea-waves increases with the depth of the ocean. He suggests that the position of the epicenter may be determined by observations of the time of occurrence or the direction of the motion. And, though unable, as we still are, to ascertain the depth of the focus, he makes a "random guess" that, in the case of the Lisbon earthquake, it was not less than a mile or a mile and a half and probably not more than three miles. Michell's theoretical views exercised no slight influence on those of his successors. Their chief interest at present is to show how far we have traveled during the nineteenth century.

To describe adequately the progress that has been made would, therefore, be almost the same as to summarize our present knowledge. Nevertheless, there are certain salient features in the history of the subject to which at the beginning of a new century it seems desirable to direct attention.

(1) During the first half of the past century, the contributions were comparatively few in number. Among the most important may be mentioned Darwin's memoir on the volcanic phenomena of South America, and the commencement of the long series of earthquake-catalogues compiled with unfailing industry by Alexis Perrey of Dijon, between the years 1843 and 1874. It would be difficult to investigate the seismic history of any portion of the earth without recourse to one or more of Perrey's valued works.

(2) The foundation of seismology was laid in 1846, when Robert Mallet applied the known laws of wave-motion in solids to the phenomena of earthquakes. Obvious as such an application may seem at the present day, and suggested as it had been by Michell, Thomas Young and others, one cannot estimate Mallet's performance too highly. Though his views on many points are superseded, he threw fresh light on the bearing of facts already known, invented much of the existing terminology, and determined experimentally the velocity of earth-waves in several different rocks. The catalogue of recorded earthquakes, prepared with the help of his son, will long be a book of reference to seismologists. But Mallet's greatest achievement was the investigation, by methods due almost entirely to himself, of the earthquake which devastated the kingdom of Naples in December, 1857. No clearer evidence could be furnished of the abiding influence of his labors than the fact that, out of about 3,000 observers of the recent Hereford earthquake, nearly 500 at once recorded the direction of the shock.

(3) To appreciate the importance of the next step, one has only to read first the article on "Earthquakes," published in 1877 in the Encyclopædia Britannica, and then that on the "Seismometer," which appeared nine years later in the same work. During the interval, seismographs based on scientific principles were invented by Profs. Ewing, Gray and Milne, and their value tested by records of numerous earthquakes in Japan. A modern seismological observatory, indeed, can hardly be regarded as complete if it does not contain either the Gray-Milne or Ewing's three-component seismograph.

While these instruments were expressly made to meet a long-felt want, we are indebted almost to accident for the use of the various forms of the horizontal pendulum which have proved so serviceable in the investigation of distant earthquakes. Hengeller in 1832, Gerard in 1851, Close and Zöllner in 1869, the Darwins in 1880, and von Rebeur-Paschwitz in 1887, all designed the instrument for purposes foreign to seismology, but nevertheless prepared the way for the detailed changes introduced during the last eight years by Milne, Ehlert, Grablovitz, Cancani, and Omori. Good results have also been obtained by means of the long and heavy pendulums favored by Italian observers.

(4) Changes in the amplitude, period and direction of earthquake-vibrations are readily distinguished without instrumental aid; but seismographs have done more than merely add precision to the evidence of our senses. They have rendered manifest features of the earthquake-motion that would otherwise have passed unnoticed. Still more interesting are the revelations of the horizontal pendulum with regard to the pulsations of distant earthquakes. By the disturbance of magnetographs, levels, or lakes, the propagation of surface undulations to immense distances had been known for more than a century. For the fuller knowledge gained during the last twelve years, we are indebted to the late von Rebeur-Paschwitz and those upon whom his mantle has fallen—Prof. Milne, Dr. Agamennone, Mr. Oldham and others. Much still remains to be learned in this fascinating field of inquiry, but it is no slight feat to have proved that, in an earthquake, two series of elastic waves traverse the body of the earth with velocities of not less than 9 and 5 1-3 kilometers per second respectively; while the slow-period undulations spread over the surface at the rate of 3 kilometers per second, the latter having been traced to distances of more than four-fifths of the earth's circumference. It is an achievement worthy of the last years of the century.

(5) While the more obvious earthquake phenomena were well known fifty years ago, closer study has revealed others of equal importance. Statistical inquiries have proved that earthquakes are far more numerous than was formerly supposed, the most modern estimate being that one takes place on an average every half-hour. Harmonic analysis of the seismic records of different countries indicates a distinct periodicity in the occurrence of earthquakes, the maximum of the annual period being as a rule in the local winter and that of the diurnal period at noon. The latest seismic maps, in which epicenters are marked instead of disturbed areas, have led to the conclusion that the most sensitive regions are those in which the mean surface-slope is greatest; while the Japanese earthquake of 1891 and the Indian earthquake of 1897 have shown how rapid may be the rate of terrestrial change.

(6) Following the example of Mallet, detailed histories of important earthquakes have been published by various workers during the last twenty years; particularly of the Ischian, Andalusian, Charleston, Riviera, Zante, Laibach, Hereford and Indian earthquakes. Seismological committees or departments have been established in several countries. Thanks to the work of Milne and Omori in Japan, of Saderra and Coronas in the Philippines, of de Rossi, Agamennone, Baratta and Mercalli in Italy, of Eginitis and Papa-

vasiliou in Greece, and many others, some of the finest seismic regions in the world are now secure from neglect. To the labors of von Rebeur-Paschwitz, Milne, and Gerland, in founding a seismic survey of the world, we may look forward with confidence to obtaining a rich harvest of results.

(7) Concurrently with the growth in our knowledge, the origin of earthquakes has become more clearly understood. There are many shocks, marked as a rule by small disturbed areas and abnormal intensity near the center, which we can hardly err in attributing to volcanic action in some cases, and in others to local disturbances partly natural and partly artificial. But all severe earthquakes, and the majority of slight ones, we seem to be equally justified in connecting with the formation of faults. In regarding earthquakes as the passing effects of the gradual but intermittent growth of faults, we are relying on a source of energy competent to produce the strongest as well as the weakest shock. At the same time, we are investing earthquakes with a significance which they certainly did not possess for us at the beginning of the nineteenth century, as indices of the site and epoch of the changes that are now taking place in the earth's crust.

SANITARY PROVISIONS IN THE ROMAN COLONY AT LINCOLN, ENGLAND.

For several years Dr. William O'Neill, of Lincoln, England, has been studying the Roman remains at that city, and at the congress of the Royal Institute of Public Health he read a paper on the sanitary arrangements of the buildings and of the old city itself. The following extracts give some of the more interesting of his statements, says The Engineering Record:

Many of the towns and villages built by the Romans in Lincolnshire remain to the present day, and several of their great works are used for the purposes for which they were made. The Roman dykes and drains, such as the Great Carr Dyke which ran from Lincoln to Peterborough, forty miles, parts of which are still in use, and the Foss Dyke, that connects Lincoln with the river Trent, were not only works of the greatest utility, but were also land cuttings of vast sanitary importance, and must have immensely improved the health of the people through whose districts than ran by drawing off stagnant water. Of the numerous towns built by the Romans, Lindum Colonia was one of the most important. In these days Lincoln is divided into uphill and downhill, but in the time of the Roman occupation it was altogether uphill, and from its elevated position looked down southward on the valley below and the River Witham flowing tranquilly toward the sea. The form of Lindum Colonia was that of a parallelogram divided into four equal parts by two streets which crossed each other at right angles. At the extremity of each street there was a massive gate, one of which still remains. On three sides there was a deep ditch, but on the southern side the steepness of the hill rendered a fosse unnecessary.

Roman Lindum possessed two of the ingredients necessary for perfect sanitation, namely, a good drainage and an abundant supply of fine water. The drainage, indeed, seems to have been perfect, if we may judge from the number of sewers that are found wherever deep diggings are made. The large sewers were constructed of bricks and cement, and the smaller drains of glazed earthenware pipes of about 2 feet in length, joined together by rings of cement placed outside. Standing, as Lindum did then, for the most part on the top of a hill, it was advantageously placed for the escape of sewage into the river below. Water was conveyed into Lindum by pipes from springs on the high grounds in the neighborhood. They are made of dense well-glazed red pottery of a superior kind. The pipes are about 4 feet in length, 8 inches in diameter, and are united by joints similar to those of a flute. One of the springs which was utilized by the Romans is two and a half miles from the city. Several large cisterns have been discovered for the storing of water.

Lindum Colonia had its vast granaries against the time of need, its hypocausts for heating and warming purposes, and its sudatories or Turkish baths. Two of these latter have been found, one of which had been a grand place. It had its stone pillars, its plastered walls painted red, blue and other colors, and its floorings decorated with white tesseræ worked into various patterns. The Romans did all they could to preserve the health as well as the olfactory nerves of the people who had to come in contact with the dead. It would appear, however, that there was some diversity of opinion as regards the merits and demerits of burying and burning. Cremation was practised by the Romans in Lincoln and so was burial, for stone coffins have frequently been dug up, and some of them have been lettered and dated in the Latin language, almost similar to the way tombstones are engraved at the present day. The Romans seem to have been firm believers in disinfectants, and especially in lime and charcoal, for they used them in great abundance in coffins and other places where disagreeable odors and decomposition were likely to take place.

In 1884 an interesting discovery of Roman remains was made about 100 yards north of the cathedral. Workmen, while clearing out the foundations of an old house for the purpose of rebuilding it, laid bare a crematory furnace, near the door of which lay a quantity of charcoal ready for use. The charcoal looked as fresh as if it had only been made the day before. About 8 feet from the furnace, on a lower plane, the men next brought into view a small chamber 6 feet long, 4 feet broad and 5 feet deep. It was built of stone, and had a heavy stone lid. When the lid was raised there were found underneath a layer of pulverized charcoal, and under the charcoal a layer of lime, embedded in which were ten one-handled vessels, in shape somewhat like a water jug or coffee pot. They were all in an upright position excepting one, and all contained charred bones and ashes of the dead. The vessels were in various colors, but none of them in the slightest degree approached in form the conventional shaped cinerary urn. Eight or 10 feet north of the sarcophagus the workmen next laid bare an arched stone doorway 6 feet high and 2 feet wide that opened into a small room in which were found five or six very large handsomely-shaped urns. They also contained charred bones and ashes, and were of a dark color, and some of them had ornamental designs impressed on the pottery. The vessels were embedded in lime, and the contents were covered over with powdered charcoal firmly pressed down. It is probable that after the body had been cremated in the ordinary way, the remains were collected and placed in this large urn, and it, with its contents, again subjected to the fire of the furnace.

A few particulars of the sanitary arrangements of a private house can be obtained from the remains of a villa discovered in the Greetwell Fields, about a mile east of Lincoln. It was situated on a hill and looked southward, and the main body of the building formed a square, each side of which measured 40 yards. The remains were 2 or 3 feet below the surface of the ground, and consisted of little more than the floors of the basement apartments. The south side or front of the house was composed of four apartments of about 30 feet each in length. But the front was extended by a corridor (south corridor) 10 feet broad, which ran 40 yards eastward. In the back, or north of the front rooms, there were several others, all the floors of which were beautifully inlaid with white, red and blue tesseræ, in carpet-like patterns, no two being alike. There was one large square room floored with 15 x 10½-inch red tiles. These tiles bore a checkered impressed pattern, and were similar to those mentioned by Pliny. It was difficult to ascertain the kind of material that formed some of the partition walls of the inner rooms owing to the decay, but they were probably constructed of wood and plastered with cement.

LARS MÖLLER, THE EDITOR OF GREENLAND'S NEWSPAPER.

From one of the front rooms three or four neat stone steps led down to a bath room, a room which was considered of importance by the Romans, who frequently received visitors while in the bath. This room was the most advanced structure of the villa, and faced southward. From the east end of the north wall the bath extended 7 feet southward along the east wall. The bath was 3 feet 6 inches in breadth, and its sides rose about 2 feet from the floor. The floor of this handsome little room was made of white china clay tesseræ of about 1½ inches square, and which were firmly set in concrete. Similar tesseræ were extended up the sides of the walls to form a dado, and tesseræ were also placed on the outside of the bath, but the surface of the inner side was quite smooth. Two or 3 feet north of the bath room was a very deep well, 7 feet in diameter; the water of this well no doubt was used in the bath room, and from the bath room a well-constructed drain pipe carried off the waste water. The same sanitary contrivance was found in the basement room of a Roman house laid bare in Exchequer Gate, Lincoln, near the west front of the cathedral. The walls of the bath room in the Greetwell villa were painted a creamy white, and the decorations were executed in reds, yellows, blues, greens and black.

INERT GASES IN THE EARTH'S ATMOSPHERE.

Profs. Liveing and Dewar have lately studied the inert gases of our atmosphere by liquefying air by contact with the cooled walls of a vessel at —200 deg. C. The more volatile portion was distilled over into spectrum tubes after it had been freed from every trace of nitrogen, argon and the compounds of carbon. The tubes showed the spectra of hydrogen, helium and neon with great brilliancy, and also a large number of other lines which could not be referred to any known origin. This result showed that a sensible proportion of hydrogen exists in the earth's atmosphere, a point that has been much disputed. Owing to the velocity of the hydrogen molecule it has been taken for granted that free hydrogen would escape to outside space. If this be true, and if hydrogen is, nevertheless, present in our atmosphere it is argued that there must be a continued accession of hydrogen to the atmosphere from outside space, as well as a continued escape. It is likely, too, that there will be a similar transfer of other gases; and the authors therefore sought for the characteristic lines of the nebulæ of the aurora and of the solar corona.

Nebular lines were, in fact found and in such conditions as to suggest that some of the (unknown) gas that makes up the nebulæ is really present, in small quantities, in our atmosphere. Several lines were seen that may be coronal in their origin. It is not certain that aurora lines were visible. The importance of these particular experiments lies in the fact that they open up a new method of attacking old problems and assure success.

NEED OF A GREAT TELESCOPE IN THE SOUTHERN HEMISPHERE.

In his annual report, just issued, the director of the Harvard College Observatory, Prof. Pickering, again refers to the need of a large telescope in the southern hemisphere to carry on work that cannot be done by the instruments set up at the Lick, Yerkes, Princeton, Washington, Charlottesville and other observatories in America; at Greenwich, Cambridge, Paris, Potsdam, Strasburg, Milan, St. Petersburg and other observatories in Europe and England. These great instruments are fully employed on specially difficult problems relating to stars of the northern hemisphere. The great reflector of Melbourne is now little used, and the same is true of the refractor of the Royal Observatory at the Cape of Good Hope.

It is of the highest importance to provide for special work on the extreme southern stars and a great telescope installed at some elevated station in the southern hemisphere—at Arequipa in Peru, for example, where the Harvard College Observatory maintains a fully equipped observing station at an altitude of more than 8,000 feet. The cost of such a telescope of the largest size would be about $100,000, and an equal sum would be required for a building and for the incidental expenses of installation. In order to keep the instrument at work at its full capacity the services of three astronomers would be required and provision would have to be made for their support.

The field for work is boundless and at the same time there are certain definite problems demanding attention—such, for example, as a spectroscopic determination of the motion of the southern stars in the line of sight. Work of this sort is fully attended to in the northern hemisphere, but the final results, which will give the motion of our solar system in space, cannot be attained until corresponding observations are made upon all the brighter stars of the southern hemisphere.

What large-pursed and broad-minded citizen will supply the need? says The New York Sun.

THE FIRST FOUR CLERICALLY MARRIED COUPLES OF GREENLAND.

THE GLASGOW INTERNATIONAL EXHIBITION, 1901.

What will undoubtedly be the most complete and important exhibition ever held in the United Kingdom in connection with industries and the mechanical arts will be inaugurated at Glasgow early in March by King Edward VII. The site of the exhibition is practically identical with that of the exhibition of 1888, and the two undertakings are specially linked together. The 1888 exhibition was visited by over 6,000,000 people, and left a clear surplus of £54,000, which surplus, with accumulated interest, has been supplemented by the subscriptions of private citizens to the amount of £74,346 and applied to the erection of fine art galleries, which form one part of the 1901 exhibition buildings. These galleries cost about £250,000, and are of permanent character. The site, which extends to 67 acres, has been granted by the corporation of Glasgow, and is one of exceptional beauty. It comprises the western portion of the Kelvingrove Park, and the Bunhouse grounds. The river Kelvin intersects it, and the slopes of Gilmorehill, crowned by the university buildings, bound it on the north. The ornamental flower plots, ponds and fountains of the Kelvingrove Park are included in the exhibition grounds, and the terraces in front of the university are well adapted for the effective display of electric lighting and pyrotechnic illuminations, as well as for musical promenades and other entertainments, of which there is liberal provision. The river Kelvin is also available for the exhibition of naval shipbuilding and lifesaving apparatus, both in motion and stationary. The reach of the river to be utilized for this purpose has a length of 1,500 feet, a width of 90 feet, and a depth of 6 feet.

The exhibition buildings, which are from the design of James Miller, Glasgow, cover an area, inclusive of the permanent fine art galleries, of about 20 acres. Apart from these art galleries there are three main groups of buildings, comprising the General Industrial Section, the Machinery Hall, and the grand hall for entertainments. The main or industrial section, with the grand dome in the center, is 700 feet long and 360 feet wide, and covers nearly 6 acres. Through the center runs the main avenue, 700 feet long, 60 feet in width, and about 70 feet high, having a circular arched steel roof. This main avenue is not in any way separated from the side wings, but the whole space is one unbroken area, save for the roof standards, which will be of open girder pattern. By this arrangement expanse and idea of space is given to the interior, and the exhibits can be arranged in any way that may be desired.

The construction of this central portion to its full width of 360 feet, and of its extensions east and west forming the main avenue for a length of 700 feet, is generally of steel uprights and roof trusses of a design combining strength and lightness. On the walls the framework is covered with fibrous plaster boards, faced with pure white stucco, and on the roof with corrugated iron, painted to represent red tiling. The grand dome and the towers, which stand around, are also constructed of steel framework, substantially filled in and covered. In the original design the plans of the whole of the buildings were drawn out, showing steel as the structural material throughout, but when steel advanced so greatly in price the building committee arranged for timber construction for large portions of the side and wing erections.

The style of the main buildings is Spanish Renaissance, which harmonizes well with the new art galleries and lends itself to brightness and gayety of color. The leading feature of the main structure is the great dome, 80 feet in diameter, with four lofty white towers rising to a height of about 180 feet above the level of the grounds. Surrounding the dome at a height of about 100 feet from the ground is a huge balcony 400 feet in circumference and averaging 25 feet wide, forming a grand promenade, from which an extensive view of the grounds and of the city and surrounding country is obtained. This balcony is reached by spacious staircases and by powerful lifts in the towers. The grand entrance is situated under the great dome and is led up to by an extensive peristyle or colonnade 200 feet long by about 80 feet wide, with floor of white marble having an ornamental design in black. In front of the peristyle is a fine flight of steps extending the entire length of the colonnade. At each corner of the building and on the north and south fronts toward the center are pavilions about 35 feet square, each having four lofty minarets at the angles terminating with domical roofs, imparting a variety of treatment to the façades.

The central or dome portion of this main building—its most elaborate and expensive section—has been designed with the view of its being retained, if desired, as a permanent palace of recreation and entertainment in all seasons; a concert room for choral, orchestral or band performances; a hall which may also be used for bazaars, meetings, and exhibitions.

The declared object of the undertaking is to carry on an exhibition in Gasgow of the manufactures, products, industries, and material resources of all nations, and of the machinery and appliances relative thereto, and also of articles illustrative of science and art, including ethnology and archæology. Special attention is devoted to the industries and resources of the several members of the British Empire.

In planning the industrial hall difficulty was experienced in deciding upon the most suitable and economical foundations, owing to the treacherous nature of the ground covered by the buildings, which, although of a temporary nature, will be heavily loaded. The ground is mostly composed of silt and mud, and withstood a very low bearing test, but at one place near the dome rock was encountered rising nearly perpendicularly to the surface, and on this some portions of the main towers and dome were founded, while for the remaining portions special foundations had to be designed to prevent uneven settlement. Large though the structure appears from the outside, an adequate impression of the size can only be obtained by viewing the interior, which gains a light and lofty appearance by the judicious use of ironwork and by the uninterrupted floor space. The industrial hall is 690 feet in length and 328 feet wide, and is traversed along the center for its entire length by the main avenue with a roof span of 103 feet, which is contracted to 50 feet at the center by the dome supports and the adjoining four main towers. The roof of this avenue is designed on the three-hinged arch principle to counterbalance any expansion and contraction resulting from changes of temperature. The legs of the main trusses are hinged or supported on steel pins attached to steel bed plates which rest upon and are secured by means of bolts to the concrete foundations, the third hinge being placed at the apex of the roof, which is about 60 feet above the floor level. The main trusses or principals are spaced about 40 feet apart, and in addition to carrying the roof over the avenue, are saddled with the ends of the supporting girders of the side roofs to resist the wind pressure against the face walls, which is taken up and conveyed through the girders to the trusses. Thus the stability of this immense structure is almost entirely dependent upon the strength of the central span. The principals are elliptically shaped on the underside and formed of lattice steelwork. A series of elliptically-shaped open steelwork arches connects the principals along both sides of the avenue and gives entrance to the side avenues. The roof is covered with glass and corrugated iron, supported by intermediate steel rafters and purlins, ventilation being provided on either side at the ridge for the whole length of the building. The side avenues are covered with roofs of timber of a novel design, and are remarkable for lightness. They are carried by timber girders extending from and in line with the principals of the main avenue to the face walls. These roofs are also covered with corrugated steel sheathing and glass.

The grand avenue extends from the west end of the Industrial Section to the Machinery Hall, to which it is joined by means of a roofed bridge over a public road. The avenue has a length of 1,000 feet and a width of 75 feet, and the roof is formed of laminated timber ribs, semi-circular in form, spaced 15 feet apart and giving a height of 40 feet above the floor at the ridge. It is covered with glass and corrugated steel sheeting, the sides being inclosed with fibrous plaster secured to timber framing. The bridge is constructed of timber, although originally it was intended to have the structure of steel. It has a clear span of 65 feet across the road, with a smaller span on either side, and a clear width of footway for passengers of 40 feet. The bridge is supported by three main girders constructed on the cantilever principle. The cantilevers rest upon cast-iron columns, and the anchor arms are securely anchored and weighted with concrete blocks. The floor decking is supported by cross girders, and the whole is covered with a timber roof of light construction in harmony with the Machinery Hall roof.

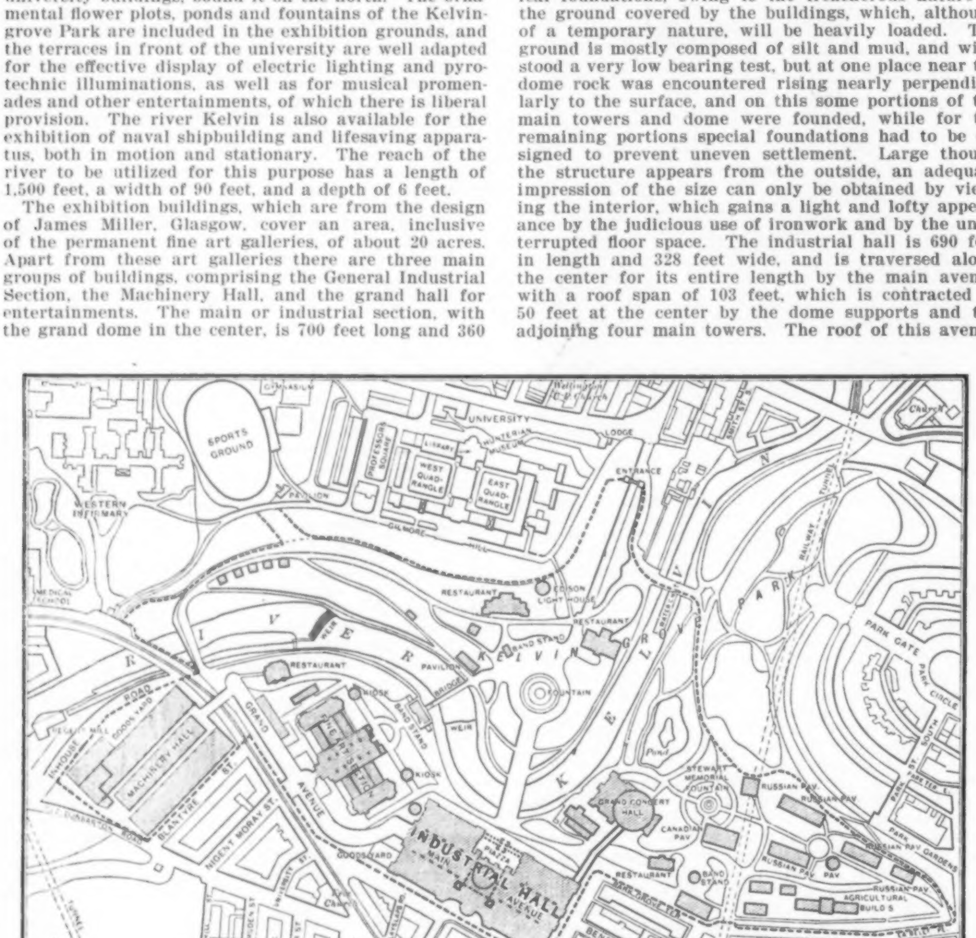
The Machinery Hall is erected on Bunhouse grounds, adjoining the park. To adapt the grounds to the purpose and to give a level floor space a large amount of excavation had to be carried out, and it was also necessary to construct a retaining wall to uphold the public road and a street. The Machinery Hall is 500 feet long and 320 feet wide. It is divided into a central avenue and four side avenues, two of the latter on each side. The central avenue, which has a span of 108 feet 6 inches, is covered by an arched steel roof of open girder work supported by double columns placed 8 feet apart and braced together by arched lattice girders. The columns, which are of steel, in addition to supporting the main roof and the adjoining side spans, also carry a gallery with lines of shafting underneath for conveying power to work the machinery exhibited. The columns, with the intermediate bracing, also resist the wind pressure from the side walls, which is conveyed to them through the roof members of the side spans. They are connected longitudinally by a double row of arched open girders of steel, which extend along either side of the central avenue from end to end of the building, and under these the gallery is carried by light lattice girders supported by cantilevers attached to the columns. The roof covering is similar to that of the other buildings. The gallery, which has a width of 16 feet, is carried right round the main avenue, and connects directly with and is on the same level as the floor of the bridge over the Dumbarton road. Access to the floor of the Machinery Hall, which is 12 feet lower, is obtained by broad flights of stairs at either end of the hall. The side roofs of the hall, which have a uniform span of 53 feet each, are supported by a series of steel latticed and tapered columns connected by latticed box girders of steel. These columns and girders also carry further lines of shafting for conveying power for working exhibits.

The Dynamo House extends beyond the main building of the Machinery Hall at its southwest corner, and is formed by a continuation of the side spans of the main building. It is about 100 feet square. The Boiler House extends along the west side, and is 204 feet long and 70 feet wide, and covers an area of 1,600 square yards. It is covered by a roof of one span of open timber work of a novel construction and is surrounded by a gallery, from which the various boilers, economizers, etc., in use can be conveniently viewed. Sidings, with loading banks and cranes, are provided alongside the boiler house and Machinery Hall in direct communication with the Caledonian Railway system for the delivery of exhibits, and a spacious covered way extends from the south end of the Machinery Hall to the platform of a passenger railway station. The principle has been adopted of giving preference to those exhibits which will make the most interesting display, and at the same time be of a representative character. The machinery will, as far as possible, be shown in motion, and, where practicable, actual manufacturing will be carried on.

The dome, which, together with its superstructure, attains a height of 200 feet with a diameter of 80 feet, is situated over the center of the main avenue, and is flanked by four massive towers about 160 feet high. It was intended that the whole of the structural framework of these erections should be of steelwork, but owing to the difficulty in obtaining the steel in time, it was decided to convert the framing of the main towers and the substructure of the dome to timber, the dome from the balcony level upward remaining of steel. As now constructed, the dome is supported upon four columns formed of massive timbers 14 inches square, firmly secured to the foundations by means of steel bolts and to each other by laminated planking 2 inches thick, secured by steel bolts and spikes. These columns extend to the height of the balcony level, where they are united by heavy timber girders and from which the recessed arches under the dome are suspended. To the inside of the main girders intermediate girders are attached, forming an octagon, on which the inner circular face of the dome is formed by outbuilding with timber and expanded metal covered with plaster. The outer faces of the dome substructure are also constructed of timber securely framed to the inner supports and to each other, and covered by laminated timber sheeting 1 inch thick in two layers placed diagonally to each other and nailed to the uprights and to each other. To this fibrous plaster facing is attached. This method of construction has been very successfully adopted in America. At the balcony level the inner and outer supports of the dome are securely tied together by a steel and concrete platform, from which the steel latticed dome ribs—16 in number—rise. These ribs are united at intervals by horizontal stiffening girders and steel wind bracing and at the crown by a circular girder, upon which the *fleche* is supported. The dome is covered on the outside with timber and sheet iron and internally with fibrous plaster. The main towers are also formed of timber uprights, about 2 feet apart, covered with laminated timber and fibrous plaster, as in the case of the outer supports of the dome substructure, the whole being firmly connected with the foundations.

Four white towers rise to a height of about 186 feet, and between these towers is the promenade balcony, before mentioned. Under the dome is the grand entrance, approached by an extensive piazza with a peristyle or colonnade 200 feet long by about 80 feet wide. At each corner of the building and on the north and south fronts toward the center are pavilions about 35 feet square, each having four lofty minarets at the angles, terminating in domed roofs.

The following receive particularly full representation: Electricity, locomotives and transport, laborsaving machinery, marine engineering and shipbuilding, women's industries, fine arts, history and archæology. Marine engineering and shipbuilding form a leading feature of the exhibition. There will be a great collection of models of ships, enabling the visitor to grasp the many epochs of progress in the construction and working of vessels during the past century.



PLAN OF THE GLASGOW EXHIBITION GROUNDS.

The models are sub-classed into passenger ships, cargo ships, men-of-war, yachts, etc. They show the transition stages of conversion from wood to iron and steel, from sail to steam, from paddle to screw, from single to compound engines, from compound to triple-expansion engines, and other interesting directions in which development has progressed. It will thus be a history of the advances in every department. The Clyde trustees show the results of their work on the Clyde by means of models of the river, representing it as it existed in the year 1800, and as it is in 1901. These show also the increase in the area occupied by shipyards and engine works and in the growth of docks, wharfage, etc.

Russia takes an important part in this exhibition, being, indeed, next to Great Britain, the largest exhibitor. The dispatch of M. de Witte, Minister of Finance, to the Lord Provost of Glasgow, announcing the Czar's desire that Russia should be largely represented, was something like a message of peace from the initiator of The Hague conference, for it ran that "the participation of Russia in the Glasgow Exhibition will be a new step toward the establishment and consolidation of the amiable relations which are so important for both countries." So large were the demands of Russia for space that a section of ground has had to be set apart entirely for her requirements. The government of the Czar made a grant of £30,000 for the erection of suitable buildings, and Imperial Commissioners were appointed to prepare and supervise the Russian Section. At the beginning of the year a band of workmen arrived from St. Petersburg to prepare for the first official representation of Russia at an international exhibition within the United Kingdom.

Over 2 acres are required to accommodate the buildings sanctioned by the government. The four principal pavilions are devoted to agriculture, minerals, forestry, and the products of the Imperial estates. All are designed in old Russian style, and the ornamentation and other features are exactly as they appear to-day in the northern parts of the empire. M. Schechtal, of Moscow, is the architect, and the work was carried out under the immediate supervision of his assistant, M. Zalenko. The largest building is reserved for agriculture. The 160 workmen expressly brought from St. Petersburg worked for 10 hours daily, spite of short days and bad weather, and though their methods seemed slow, no time was lost and the work of the Muscovites compares favorably with that of the home carpenters. Few tools are used by the Russians. A short-handled ax is the favorite instrument, and it serves for all kinds of jobs. Cranes and kindred appliances were not required to raise the heavy logs—only a cable and a chorus. After the original plans were passed it was decided to erect two smaller pavilions—one for a collection of grain from all the producing districts, the other for the use of the Millers' Association of Russia. A grand reception hall is for the use of distinguished visitors from Russia. In the Industrial Hall Russia has over 11,000 square feet of space for a varied display of the country's manufactures, laid out in saloons, *bureaux*, and cases of all shapes and sizes. Textiles, furs, etc., are to be prominent, and other Russian exhibits include india rubber and leather goods, silver and china ware, painted glass, jewelry, statuary, lacquered goods, perfumery, pianos and musical instruments peculiar to the country. Various chemicals will also be shown, paper of all kinds, horn goods, matches, soaps, candles, etc. White-costumed waiters with purple sashes will serve Russian foods and drinks in a Russian restaurant. Russian military bands will play, a Russian choir will sing, Russian women will work at native industries, and it is expected that the Russian Emperor himself will visit the peaceful and peace-making gathering at Kelvingrove.

Large space has been taken by United States manufacturers and others. Canada has a special building covering 12,000 square feet for the display of the mineral, agricultural, and manufacturing products of the Dominion. Japan has also a special building placed in the center of a Japanese garden, in which practical illustration will be given of the arts and industries of the Land of the Rising Sun. France has a large section supervised by a government committee. And other specially interesting sections are filled by Denmark, Austria, India, Mexico, Morocco, Persia, South Africa, Rhodesia, and the Commonwealth of Australia.

Very complete arrangements have been made for the catering and recreation of visitors. While the show is in progress the University of Glasgow will celebrate the four hundred and fiftieth anniversary of its foundation. And during the summer and autumn the British Association, the Institute of Mechanical Engineers, the Institute of Chemical Industries, the Society of Engineers and Shipbuilders, the Institute of Naval Architects and other learned societies will hold their annual congresses in Glasgow.—The Iron Age.

ANIMAL DISEASES AND ANIMAL FOOD.*

By D. E. SALMON, D.V.M., Chairman, Washington, D. C.

YOUR committee, to which has been referred the important subject of animal diseases and animal food, has given much attention to the developments of the year in this direction, but only finds it desirable to invite the attention of this Association to a very few topics.

GLANDERS.

It has come to the notice of your committee that during the last two years there have been in some localities an unusual number of cases of glanders in horses. This increase has been observed in widely separated States, and over a considerable extent of territory. As glanders is a disease easily communicated and fatal to man, these observations are of especial interest to this Association, particularly in these days when serum from horses is so largely used in the treatment of human diseases. The more prevalent is this disease, the greater should be the care exercised in the selection of horses for the production of serum. It is, therefore, more important at this day to eradicate glanders than ever before. We have not only the danger of accidental infection to those who come in actual contact with the affected horses, but we have in view the very desirable object of maintaining the reputation of our horses for healthfulness, since they have become the source of remedial agents of world-wide use.

It has been the experience of all countries that glanders increases in army horses during the progress of a war. The necessities of military operations often require the hurried collection of horses, the omission of the usual precautions against contagion, the most severe physical exertions, and the sustenance of the animals upon minimum rations—conditions which favor the introduction and propagation of the glanders contagion.

The short war with Spain was no exception to the rule, and the army horses became extensively infected, carrying the contagion after the conclusion of hostilities to various parts of the country. Whether this method of dissemination accounts for the entire increase in the disease, your committee has not the means of ascertaining, but it is worthy of remark in this connection that the United States Army appears to be the only one among civilized nations which does not have an organized and commissioned veterinary service to guard the health of its animals. The veterinarians at present are employed as civilians; they are distributed among the cavalry regiments with no bond of union. There is no professional head to the service to make regulations; to hold the regimental veterinarians responsible for intelligent action, and to instruct them as to their action in the case of emergencies. There need be no surprise, therefore, that when we have even a short war disease, and especially glanders, becomes epizoötic and develops beyond control.

RABIES.

There has come to the attention of your committee during the year information which demonstrates the frequency of rabies in the United States, and which indicates that the disease is becoming more common. This result is not entirely unexpected when we consider the increase in the canine population of the country and the fact that measures of control are but seldom adopted, being at best of temporary application and lacking in thoroughness.

In an outbreak of rabies at Buffalo, N. Y., the Health Department carefully investigated 95 cases of furious rabies in dogs, and 35 cases of dumb rabies. Many other cases occurred which were not investigated. Four persons were victims of this outbreak. In the District of Columbia there has also been a serious outbreak of this disease—during the year ending June 20, 1900, 45 cases in dogs, 4 in cattle, 1 in the cat, and 1 in the horse. In each of these cases the nature of the disease was demonstrated by inoculation experiments made by the Bureau of Animal Industry. That bureau has also made observations in previous years, and has demonstrated by inoculation experiments the following cases in dogs: 1893, 11; 1895, 2; 1896, 5; 1897, 3; 1898, 7; 1899, January 1 to June 30, 4. Other outbreaks have been reported to your committee from Maryland, New Jersey, Pennsylvania and Minnesota, all with positive evidence of the character of the disease. Information of similar outbreaks in several other States has been received, but your committee has not had an opportunity to investigate and establish their character by incontrovertible evidence. While about twenty persons were bitten in the District of Columbia during the year, nearly or quite all of them took the Pasteur treatment and no deaths have occurred. From various parts of the country have been received accounts of disease and death of numerous domesticated animals of different species with the symptoms of rabies. Some of these have been investigated, notably the death of 18 cows at the Governmental Hospital for the Insane in the District of Columbia, and the diagnosis confirmed by inoculation experiments.

Fatal as is the disease in man, and your committee is of the opinion that no single case has been known to have recovered; agonizing and terrible beyond description as are the sufferings of the human patient, your committee finds its greatest cause for alarm not in the dreadful nature of the disease, nor yet in the difficulties attending its control by sanitary measures, but in the existence in the United States of numerous societies with large membership which are deliberate and active in the circulation of literature calculated to deceive the people as to the existence of this disease, and to develop obstacles and resistance to the health officers in their efforts to eradicate it. So marked has been the effect of this literature, even at the capital of this advanced and intelligent country, with all its education and science, that the order for muzzling dogs during the outbreak could not be enforced, and all regulations for the control of the outbreak were finally abandoned.

It is most unfortunate that some members of the medical profession have joined in this crusade to discredit the results of the experimental studies of this disease—scientific studies which began with the century and are still being continued. Their sincerity and honesty are not questioned, but surely where there is so much at stake for the human race, and where it is so easy to repeat the crucial experiments upon which our science rests, these gentlemen owe it to their own reputations and, above all, they owe it to their profession to make a careful investigation before distributing broadcast to the laity their misleading and deceptive statements. One of these gentlemen advertised in a newspaper of the city of Washington offering a reward of $100 for a case of rabies in man or animal. The chairman of your committee offered to produce a case at any time if the diagnosis were left to a committee to be appointed by the Medical Society of the District of Columbia, the money, in case it was earned, to go to a charitable society. This proposition has never been accepted. Another gentleman has publicly stated that he has sought for a case of rabies for sixteen years without being able to find one, and yet in his own city, at the Veterinary Department of the University of Pennsylvania, there have been numerous cases nearly every year, characteristic and well authenticated, which he could have seen and investigated by merely asking permission. It has been frequently asserted that there has not been a single well-established case of either rabies or hydrophobia in the great city of New York for the past thirty years, and yet the records of the American Veterinary College show an average of seven cases a year for twenty-five years, and the bacteriologist of the Department of Health of that city has, during the last three years, confirmed the diagnosis of rabies in forty cases in domestic animals and in three cases of mankind.

This is a country governed by the people, and health officers cannot go far beyond the sentiment of their constituency without meeting with the most serious checks and reverses. If the people know the facts there should be no difficulty in stamping out such a dangerous and dreaded contagion; but in a community prejudiced by misleading statements, inflamed by assurances that there is no danger and that the measures adopted are relics of barbarism forced upon the citizens by ignorant and unscrupulous health officers—in such a community it is difficult or impossible for the sanitarian to afford relief.

Your committee is firm in the belief that some means should be devised of educating the public upon this subject. The agencies of misinformation are numerous and far reaching; not only are there special journals maintained by the societies referred to, but open letters have been sent to the editors of all newspapers asking them to suppress accounts of this disease, and furnishing them literature by which to convince their readers of its non-existence. It is not too much to expect that the members of this Association will in their several spheres be active in the dissemination of truth and in combating the plausible and deceptive fallacies to which reference has been made.

TUBERCULOSIS.

Your committee finds in the tuberculosis of animals a disease of transcendent interest, not only because of its effect in lessening the food supply, but because of its deleterious influence upon food products and the possibility of the contagion being transmitted to man and causing fatal results. Seven years ago in discussing this subject your committee advised conservative and moderate action, with a view of gaining time for educational work, and allowing dairymen an opportunity of gradually reducing the disease in order to avoid burdensome losses.

The developments of the intervening time have not been as satisfactory as we had reason to expect. In some States the authorities were too radical and harsh in their proceedings, and the result has been practical stoppage and failure of their efforts. In other States there has been a ceaseless agitation against and denunciation of the tuberculin test, the only effectual means of discovering the disease in living animals. Every argument has been used to make the efforts of those who were trying to eradicate the disease appear to be unreasonable, unnecessary and an uncalled-for persecution of the cattle owners. Not only have these agitators insisted upon the right to furnish the public with dairy products from tuberculous animals, but they have cultivated the sentiment that tuberculosis is not a bad thing to have in a herd. The situation as it exists to-day is one of the most vivid examples that we could have of the difficulty of protecting human health and human life where we have on the one side the consideration of commercial gain and personal aggrandizement, and on the other the claims of humanity.

In a few States good work is being done, and the disease is being diminished. In most States there is either no effort being made to repress the disease, or such effort is too feeble to have any appreciable effect beyond the irritation of the cattle owners. In the meantime it has become apparent that swine are affected to an extent which is calculated to bring disquiet to those who know that with these animals the disease is usually acute and often generalized. As swine are generally fed with skim milk and buttermilk, it is to be expected that tuberculosis will increase with them in the same proportion that it does with cattle. The changes in dairy methods which have led to the establishment of creameries have probably contributed to the dissemination of tuberculosis among swine. If, for example, there is only one tuberculous herd of cows in a community the infectious milk of that herd would be mixed at the creamery with the milk of all the other patrons of the establishment, and would thus infect the whole. The skim milk and buttermilk afterward divided and returned to the several farms might infect every herd of swine in that community. This danger might be counteracted by sterilizing the waste products before they are allowed to leave the creamery, but this precaution is usually neglected.

Your committee has carefully considered the arguments of those who oppose action for the control of tuberculosis, and asks your indulgence while some brief references are made to them. The one assertion which includes all others is that bovine tuberculosis is not communicable to man and hence the sanitarian is not warranted in causing animals so affected to be removed from dairy herds. If this contention were demonstrated, would the conclusion necessarily follow? Evidently not. Consider, if you please, a herd like that belonging to Her Majesty the Queen, and which furnished milk for use at Windsor—and there are many such herds, and not all of them in Great Britain. This herd was under veterinary supervision and was believed to be healthy, yet when tested with tuberculin 90 per cent were found tuberculous, and upon post-mortem examination some of them revealed most extensive lesions. Is it conceivable that a cow will give normal and wholesome milk when it has a whole lung transformed into a tuberculous mass, with tubercles disseminated through the liver and other organs, and with, perhaps, tuberculosis of the milk ducts as well? Would any one knowing the animal's condition be willing to drink the milk from such a cow, or give it as food to his children, even if satisfied that the specific disease tuberculosis could not be transmitted in that manner?

It appears important that the milk supply should come from healthy cows, and that any animal having extensive inflammation of any kind, in any organ, and particularly any disease accompanied by extensive suppuration or mixed infection, should be condemned as a milk producer. It is claimed, however, that many cows which react to tuberculin and would be destroyed

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have comparatively small lesions, and such as would not affect the quality of the milk. This may be granted as an undoubted fact; but, on the other hand, it is equally certain that almost as great a number with serious and extensive disease are discovered with tuberculin and could not be discovered in any other manner; it is also certain that a majority of those with minor lesions will in time become badly affected, and that no one can tell the day or the hour when their milk assumes a dangerous character.

Having said this of the disease without reference to its contagious character, your attention is invited to the principal arguments of those who insist that bovine tuberculosis is not communicable to man. It is scarcely necessary to remind this Association that bovine tuberculosis is caused by the bacillus tuberculosis; that this bacillus is frequently found in the milk of tuberculous cows; that the milk of such cows has been inoculated upon guinea pigs and rabbits and produced tuberculosis; that the milk of such cows has been fed to guinea pigs, rabbits, swine and calves and produced tuberculosis. So much for the well-known experimental evidence.

The conclusion which would seem to follow from this evidence that the milk of tuberculous cows is dangerous to the human consumer has been met, and the attempt has been made to counteract it, by certain experimental evidence and certain conclusions which are worthy of a critical examination. First, it has been asserted that the tubercle bacillus is only found in the milk of cows with tuberculous udders, or in that from cows in a very advanced stage of tuberculosis, and that in either case the diseased animals may be readily discovered by physical examination. This assertion has been made by men who stand high as authorities, but the evidence upon which it is based is far from satisfactory.

A short time ago the Bureau of Animal Industry tested a herd of 102 cows belonging to a government institution in the District of Columbia. Seventy-nine of these animals reacted, and as more than fifty of them were in good condition, without physical signs of tuberculosis in the udder or elsewhere, it was considered a favorable opportunity to test the infectiousness of the milk. The test to which reference will now be made was conducted by feeding the milk to guinea pigs. The final results have not yet been reached, but a large proportion of these cows, over twenty-five per cent, gave milk which killed guinea pigs with tuberculosis in a very few weeks. Dr. Ravenel has been associated with similar experimentation in Pennsylvania with an even larger number of cows, fourteen per cent of which gave infectious milk. Considering the number of cows experimented with, and the large percentage which produced infectious milk, the results cannot be passed by as exceptional, and, consequently, we can no longer accept the statement that there must be plain disease of the udder or evident emaciation before the milk becomes infectious.

In the very instructive observations and experiments made by Dr. Theobald Smith, of this association, it has been shown that there are certain morphological peculiarities and cultural characteristics which prove that the tubercle bacilli from human sputum and that from bovine tuberculosis differ considerably, and when inoculated the human bacillus is less virulent for cattle and for some other animals. These results have been confirmed and must be accepted as a valuable contribution to our knowledge of this important subject.

These facts have been taken up by those who oppose the work for the eradication of bovine tuberculosis, and conclusions drawn from them far beyond what the investigators have ever claimed. It has been defiantly asserted, for example, that because the human sputum bacillus has but slight virulence for cattle and can with difficulty, only, if at all, be made to produce extensive lesions with these animals, that it necessarily follows that the bovine bacillus is harmless to mankind. It must be evident to any pathologist that this reasoning is fallacious, but nevertheless it has had an enormous influence in shaping public opinion and in deciding legislative action in some parts of the country.

It may possibly be found that it is not safe to accept the sputum bacillus as an accurate measure of the virulence of human tuberculosis, and when the bacillus from early tubercular lesions in man is compared with the sputum bacillus there may be found important differences. But whether this turns out to be the case or not, the fact that the sputum bacillus does not readily multiply in cattle is no evidence that the bovine bacillus will not readily multiply in the human body. It is not an uncommon phenomenon that a microbe loses virulence when passed through certain species of animals and gains virulence when passed through others. Thus Pasteur found that the virus of rabies was attenuated in the bodies of monkeys; but no one would claim because rabies virus from monkeys is not virulent for dogs that, conversely, rabies virus from dogs is not virulent for monkeys.

Again we have in cow-pow and small-pox either two closely allied diseases, or, as many claim, two varieties of the same disease. Small-pox is very virulent in the human subject and easily communicated from man to man, but strangely enough it is only inoculated with some difficulty to cattle, and is then localized and produces only a mild form of disease, with a tendency to attenuation if passed from animal to animal. How far from the truth would we be if we concluded from this fact that because small-pox virus does not retain its virulence in cattle, cow-pow would not be communicable to mankind. That cow-pox is easily transmitted to man, and that it is reproduced with all its characteristics and activity, is shown by every successful vaccination.

A study of the facts of comparative pathology, therefore, does not warrant the conclusion that because the sputum bacillus is not virulent for cattle, the bovine bacillus is not virulent for man. It would be more in accordance with analogy to reason that the tubercle bacillus develops a higher virulence in cattle than in man, and that it is not only more virulent for cattle, but for man also. It has been already shown that the bovine bacillus is not only more virulent for cattle than is the sputum bacillus, but it is more virulent for guinea pigs, rabbits, swine, dogs, cats, sheep and goats. Now there is a general rule in comparative pathology that a contagion which is virulent for several widely separated or unrelated species of animals is virulent also for mankind. The contagion of anthrax, rabies, epizoötic, aphtha, glanders, malignant œdema, tetanus and cow-pox are striking examples. If this rule were applied we should be forced to conclude that the bovine bacillus is dangerous to man as well as to these various species of animals.

Come to facts of more direct application, and we have the evidence of accidental inoculations of man with the bovine bacillus which may be contrasted with the anatomical tubercle caused by similar inoculations with the human bacillus. A comparison of the recorded cases of such inoculations which we have been able to find in a cursory search of the literature indicates that the effects in man produced by the bovine bacillus have been at least as serious as those produced by the human bacillus. A member of this committee, Dr. Ravenel, has put on record three cases of inoculation of man with the bovine bacillus. Pfeiffer relates a fatal case in which the contagion was contracted in this way: Veterinarian Moses, who came of a healthy family, wounded himself in the left thumb while making an autopsy of a tuberculous cow. The wound healed without suppuration, although the knife probably penetrated the joint. After six months, however, there developed on the scar a cutaneous tubercle with disease of the joint. In about a year from the inoculation symptoms of tuberculosis of the lungs developed, ending in death six months later.

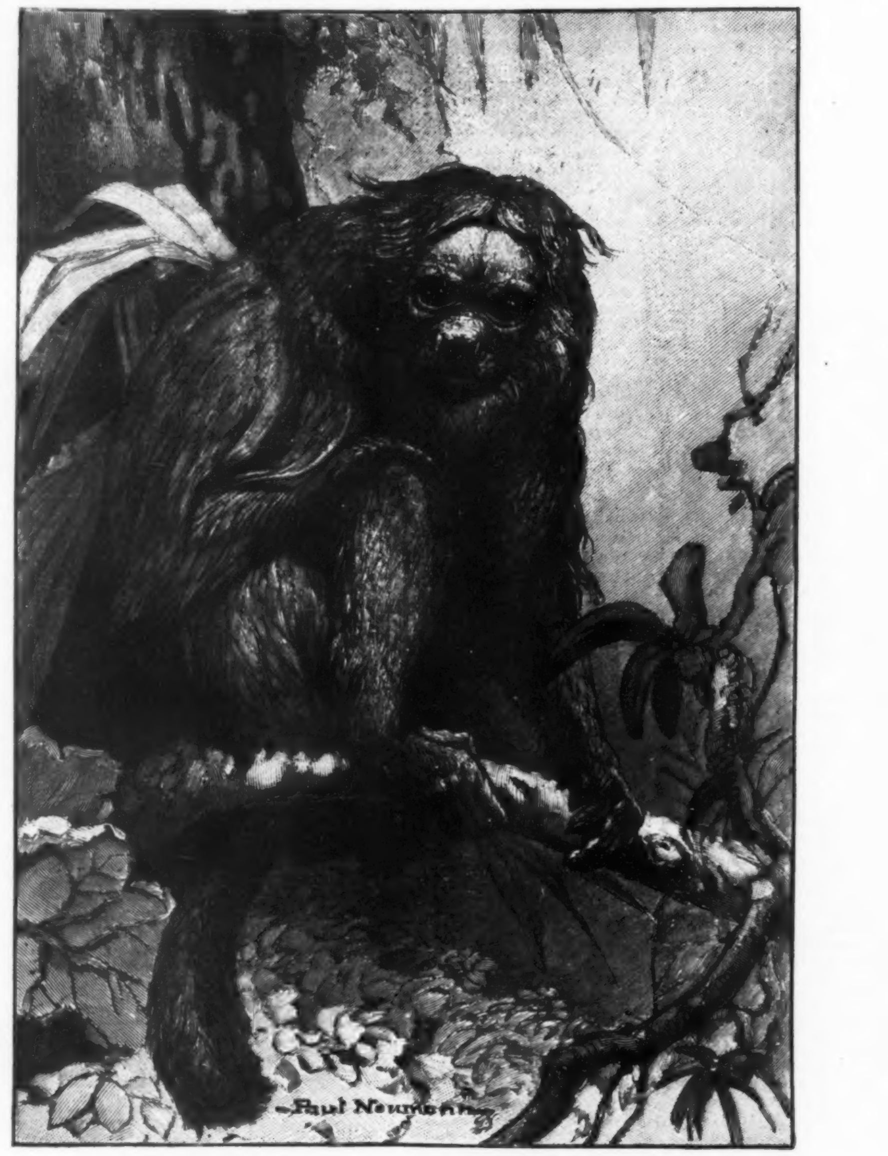
Your committee does not consider it desirable on this occasion to enter into further details in the discussion of this subject. It has presented the matter as comprehensively as is possible in a brief report, and it holds that the recent investigations not only do not weaken the older evidence as to the danger of bovine tuberculosis to human health, but that, on the contrary, they strengthen that evidence and make its application no less certain. All of which is respectfully submitted.

THE AMERICAN RED-FACED OR SHORT-TAILED APE.

Zoology and zoological gardens are not without their *nouveautés*, which, like many other truly startling things, have the fatal peculiarity of not at first attracting attention. But when the critic and connoisseur has passed judgment upon the newly-discovered variety of animal, forthwith the peculiarities are apparent to every one, and receive their full meed of popular admiration. According to Dr. Heck, in the Illustrirte Zeitung, these characteristics of the visitors of menageries are never more clearly displayed than in the monkey-house of the Berlin Zoo. The ordinary types of monkey are carelessly passed by with a glance or two; but before the cage of the red-faced, saucer-eyed ape of America, crowds gather.

It cannot be denied that there is much in this animal to arouse one's curiosity. Its brownish-red, long, but thin hair; the tail, ending with an abruptness that leads one to suppose it might have been chopped off; the singular face, almost a caricature of man, with its endless variation of expression—these characteristics alone distinguish the creature sharply from the other animals in the monkey-house.

The uakari, as the ape is called in his native country, the valley of the Amazon, is smaller than the well-known capucin monkey, but considerably larger than the squirrel monkey.



THE AMERICAN RED-FACED OR SHORT-TAILED APE.

From the observations of Bates and Humboldt, it would seem that the American short-tailed monkey is but little known even in his native land, for the reason that he rarely emerges from the dense jungle. In captivity the animal soon perishes. Thus it happens that the Berlin specimen is one of the few which are to be found in the great zoological gardens of the world.

TINTED PLASTER CASTS.

The plaster casts of fine bass reliefs that are sold on the streets all over the city lose half of their effectiveness in the glaring white of plaster. An excellent plan is to give them an old ivory tint, which at once brings all their beauties into sight. This may be done by appying a mixture of beeswax dissolved in turpentine to the consistency of thin paste, covered with burnt umber. The solution should be applied with a brush and distributed in uneven quantities. Remove all that has not been absorbed by the plaster with a piece of soft silk.—Pract. Rev.

PACKWOOD TURNED INTO COAL.

A curious case of transformation of packwood into coal has been reported by G. Arth to the French Academy. A Jonval turbine was running with its steel point on a pivot of packwood. It was a 12 horse power turbine, making 112 revolutions per minute, and the mass in motion weighed about 9 cwt. The packwood was not exactly under water, but it was always wet; it was a wood of best quality. After six months' run the turbine was dismounted, and it was observed that while the lower part of the block of wood was apparently unchanged, the upper portion on which the turbine shaft had been rotating was turned into a black mass, full of small fissures and brittle; the fracture was brilliant as in coal. The mass was analyzed in the wet and dry states, and it proved that this charred packwood occupied, by its composition as well as by its heating value, a position intermediate be-

tween lignite and coal. It gave 7,391 calories against the 8,000 of an average coal. The observation is interesting chiefly on account of the short time which this change had required. The pressure and the friction were, no doubt, somewhat considerable; but the temperature cannot have risen to a high degree. The author of the paper believes that this observation should modify our views on the length of the geological periods generally considered necessary to explain the formation of our coal fields.

THE OSMIUM LAMP.

A LECTURE was delivered January 23 by Engineer Scholz at the annual meeting of the Deutsche Gasgluhlicht Gesellschaft on the new osmium lamp invented by Dr. Auer von Welsbach. The lecturer at the outset emphasized the fact that the efficiency of an artificial source of light is greater the higher the temperature of the light-emitting surfaces. This has led to the substitution of the platinum filament by one of carbon, but even this material disintegrates in time due to the high temperature. Osmium, however, having the highest melting point of all known metals, resists such action for a very long time, but its employment in the form of a filament is of very recent origin. This has been due to the fact that up to the time that Dr. von Welsbach made his experiments, resulting in the manufacture of osmium filaments, the metal could only be procured in the form of a crystalline powder, a spongy mass, or after being molten in the electric furnace, in the form of a brittle, hard metal which could not be mechanically worked.

An osmium filament is a conductor and a lamp containing the same may be placed in an electric circuit like an ordinary incandescent lamp, no preheating devices being required. The advantage of an osmium lamp is its small current consumption for a high candle power, which in turn means that the carbon filament is worn out long before the osmium filament shows any signs of wear. Lamps requiring 1.5 watts per candle power possess a very long life, often as high as 700 hours, and frequently as high as 1,200 hours or more. A lamp which had been burning 1,500 hours was found to be in splendid condition, and had only lost 12 per cent of its original candle power. The consumption of the lamp at the beginning was 1.45 watts per candle power, and after 1,500 hours it was 1.7 watts.

Should the filament become discolored it can easily be brought back to its original state without renewing it or the bulb. On account of its greater conductivity the osmium filament requires less voltage than the carbon filament, and lamps have been constructed requiring only from 20 to 50 volts.

As most central stations, however, furnish 110 and 220 volts, it would be necessary to burn a number of the lamps in series or to transform the voltage. In the case of alternating and three-phase distribution the problem becomes simpler, as the transformers may be built to reduce the pressure to the amount required by the osmium lamps. They will probably find ample employment on accumulator circuits, as they will reduce the weight of the accumulators on account of their small energy consumption. Among such might be mentioned the lighting of automobiles and railway trains.

During the lecture the speaker connected four 25-volt osmium lamps in series and in parallel therewith four ordinary 110-volt incandescent lamps of the same candle power. The osmium lamps took 0.96 ampere, while the others required 2.4 amperes, a saving in favor of the former of 60 per cent. The heat generated is also less in the osmium lamps, and they can be made in candle powers from 2 to 200.

We are able to supplement the above information abstracted from Engineer Scholz's paper (of which a notice appeared March 2 in The Digest), by the following account of the lamp which formed a part of the recent A. I. E. E. paper by Mr. W. J. Hammer.

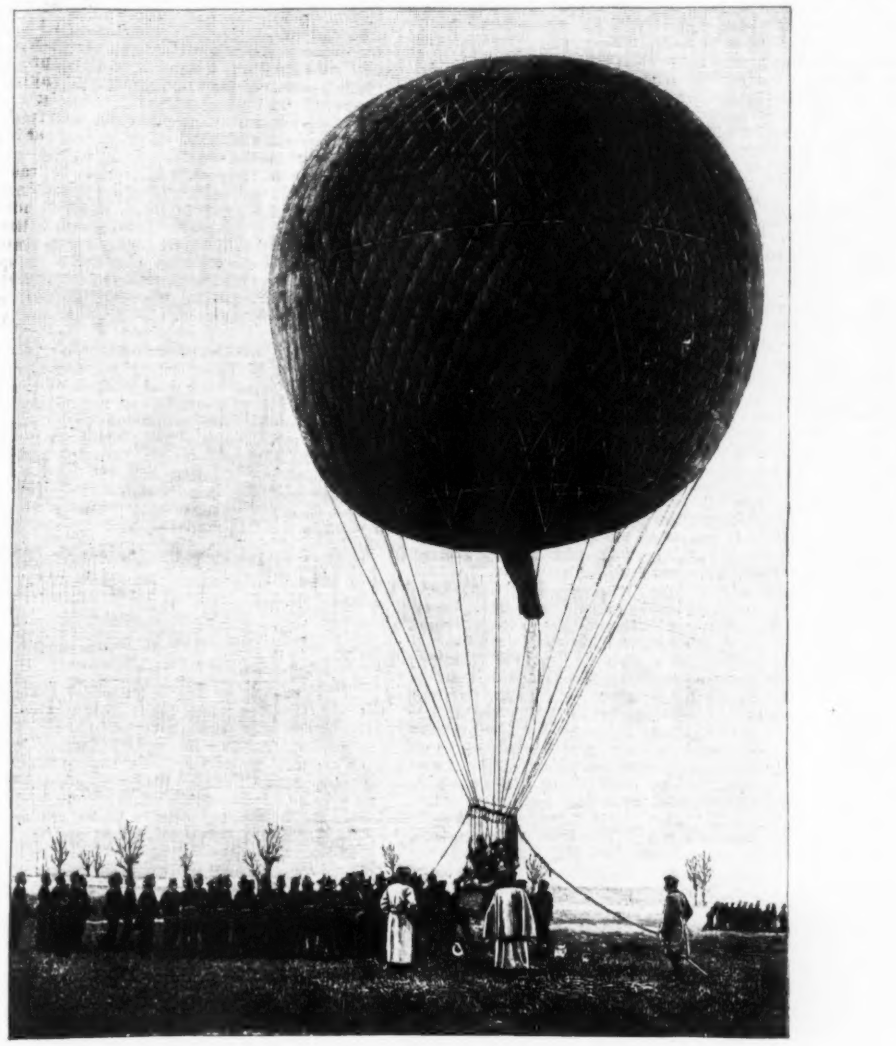
During his stay last October in Vienna Mr. Hammer, through the courtesy of Dr. Gallia, of the Auer Company, was permitted to see several of the osmium lamps burning, and while unable to secure full particulars, he learned that the lamps were operated at an e. m. f. of 25 volts, and showed an economy of from 0.9 to 1 watt per candle. The three lamps which Mr. Hammer saw in use were all connected in parallel and operated with key sockets, and differed but little in general appearance from an ordinary carbon filament lamp. The globe was somewhat longer than an ordinary 16 candle power lamp, and the filament, which was of the hairpin shape, was much longer. Mr. Hammer was told that these lamps had shown a life under test of 700 to 800 hours, and he adds that it will be interesting to learn to what extent the low voltage of the lamp and the rarity of the material used in its manufacture will affect its commercial application. It had been intended to show the osmium lamp at Paris before the close of the exhibition, but there was not sufficient time. Osmium, which was discovered by Tennant in 1803, is a blue-white metallic element, and is almost infusible. Mr. Hammer was informed in Paris, where he first heard of this lamp, that the successful method of handling this material, which has always been most difficult to work with, was due to a large extent to Mr. Waldron Shapleigh, of the American Welsbach Company, which concern controls the patent rights for the United States.—The Electrical World.

ARTIFICIAL SILK.

IN spite of many prophecies to the contrary, the manufacture of artificial silk continues to be a thriving industry. It is true that there are only certain purposes for which it can be safely used, but these purposes are so numerous and their demand so large that it is only with difficulty the supply can keep pace with the demand. The manufacture does not seem to have been successful in England, but there is no apparent reason why the English should not succeed as well as the Germans. In Germany the trade is an important one, for in the Elberfeld district alone there is a monthly output to the value of £25,000. An improvement in the process of manufacture has recently been adopted in France, in that class of material having a nitro-cellulose base. This type of artificial silk and the method of its manufacture are now well known, and it would probably be more widely used but for certain disadvantages, among which are the necessity for denitrating the product, and the fact that the material is very inflammable. The improvement avoids these disadvantages, and at the same time is said to produce an artificial silk having all the appearance of natural raw silk, together with the same strength and firmness. Dry nitro-cellulose, india-rubber solution, and a salt of tin are mixed together in suitable proportions. So far, it is found that the best results are obtained, says The Textile Manufacturer, by using as the tin salt stannous chloride, and by mixing thoroughly the several ingredients in about the following proportions: 100 pounds of dry nitro-cellulose, 7 pounds of india-rubber solution, and 5 pounds of stannous chloride, a sufficiency of a suitable solvent, such as benzine, being added to bring the mixture to the necessary working consistency. The mixture is squirted through dies to form thread, under hydraulic, pneumatic or mechanical pressure, as in the existing modes of manufacture of artificial silk of the same type.

A BALLOON VOYAGE ACROSS THE BALTIC SEA.

IN accordance with the resolutions of the International Aeronautical Commission for the advancement of scientific ballooning, ascensions are made on the first Thursday of every month from the various balloon stations distributed throughout Europe. On the 10th of January manned and unmanned balloons ascended from Berlin, Munich, Paris, Przemysl in Galicia, St. Petersburg, Strasburg, Trappes, near Paris, and Vienna. Of particular interest is the voyage made by the balloon which left Berlin; for the entire Baltic Sea was traversed and a landing made in Sweden. According to the Illustrirte Zeitung, this balloon traveled the largest distance over water which has been covered up to the present time. It is true that two French balloons have also landed in Sweden; but they crossed the Baltic Sea at very narrow portions, and were not in great danger of being driven by the wind in the longer and wider portions of the Baltic and Bothnian Seas. The German balloon which undertook this greatest of sea voyages belonged to the German Society for the Promotion of Aerial Navigation, and made its trip under the auspices of the director of the Aeronautical Observatory of the Meteorological Institute of Berlin. In the car were Dr. Berson, permanent collaborator of the Meteorological Institute, and Lieut. Hildebrandt, of the Royal Prussian Airship Division.



THE BEGINNING OF THE BALLOON JOURNEY.

It had been at first decided to make observations and measurements in the upper regions of the atmosphere, and to ascend as high as possible by throwing overboard ballast. In order to overcome the difficulty of breathing in the rarefied air of these great heights, cylinders of pure compressed oxygen were carried along. Among the instruments with which the party were equipped were an Assman aspiration-psychrometer, by which the temperature of the air is accurately ascertained independently of the influence of the sun's rays upon the column of mercury; a barograph; two aneroid barometers; a black bulb thermometer, and a spirit thermometer, which was to be used only in case the mercury of the other thermometers were to freeze. The journey began at 8:17 A. M. At a height varying from 150 to 200 meters the balloon sailed over Berlin and was soon on a level with the Aeronautical Observatory near the proving-grounds of Tegel. Herr Assman, the director of the Aeronautical Observatory, then sent up a second registering balloon—the first ascended before sunrise—the course of which was to be carefully observed by the two passengers. As Dr. Berson and Lieut. Hildebrandt were carried on they found that their balloon assumed a westerly direction at a height of about 800 meters, then verged directly to the north at a height varying from 800 to 1,400 meters, and in the higher regions sailed eastwardly. Owing to the stable condition of the atmosphere, the balloon traveled at a uniform rate of speed without the necessity of throwing overboard any ballast. The aeronauts therefore soon gave up their attempt to reach a very great height and decided to cross the Baltic. Zehdenick, Neustrelitz, Neubrandenburg were traversed or passed. At 1:15 P. M. the coast of Stralsund was reached and the western portion of Ruegen passed. Shortly after two o'clock Ruegen was left behind, and the balloon hovered completely over the sea. By reason of the extraordinarily clear atmosphere, a magnificent view was obtained of Ruegen and the chalk cliffs of Stubbenkamner and Arkona. At the distant horizon the Swedish coast appeared as a narrow, hazy strip. At 3:15 o'clock the balloon had half crossed the sea. Ruegen and Sweden were recognized only as narrow streaks. The aeronauts have described in rapturous terms the setting of the sun, which they observed shortly after four o'clock. At a height of some 1,600 meters in the clearest atmosphere imaginable, the full beauty and magnificence of a colored sunset was unfolded to them.

During this entire voyage of three and one-half hours only two steamships were sighted, of which the second apparently changed its course and steered for the balloon, but later turned aside, presumably because the balloon was in no danger. Toward five o'clock the Swedish coast was reached, and Trelleborg overpassed at a height of 600 meters. Malmoe was passed to the left, and the well-known railway junction Lund to the right. Further information respecting their course the aeronauts could not give, for complete darkness set in and the maps could no longer be seen. The two men, in their description of their journey, dwelt long upon the splendid view which they enjoyed of the Swedish towns and villages. The innumerable communities of the province of Sconen flashed up with their lights; magnificent was the view of Malmoe, Trelleborg, Copenhagen, Landskrona, Helsingeer, Helsingborg, and Lund. All these cities could be seen at once from the height of 3,000 meters, the greatest which the balloon attained. The lighthouses on the Danish and Swedish coasts were kept in sight for a long time.

At about ten o'clock clouds concealed the view of the earth and induced the aeronauts to terminate their journey. Shortly after ten o'clock, after having pierced the cloud layer, a landing was made, in deep

snow, near the village of Svenshult, near Hoga Hyltan, about 20 kilometers from the railway station of Markaryd, in the province of Smaaland. After having concealed their instruments, the aeronauts looked about them for a human habitation—a task which in a black night, in an unknown country, was by no means easy. But after some fifteen minutes of patient exploring, the dark outlines of a building were seen, the owners of which were aroused from their sleep.

The next morning the balloon was packed for shipment and the hospitable quarters were left behind.

THE TROLLEY AGE.

By ALBERT L. JOHNSON, in The Independent.

THE transportation problem of the present time may be stated thus: How shall transportation systems carry people, and the commodities necessary for their maintenance, as expeditiously as possible at a minimum cost? The steam railroads have endeavored to meet conditions; and, notwithstanding the consolidation of former independent lines into stupendous systems, and the adoption of the so-called community of interests plan where the laws will not permit of consolidation, the general trend of steam railway rates has been lower and lower every year. This reduction has not been due so much to competition between the lines themselves, which is growing less and less every year; but it has been forced by the increasing necessities of a constantly growing population and the additional commodities required for their maintenance and support.

Steam railroads, however, with their enormous overcapitalization, their excessive fixed charges and their heavy operating expenses, have nearly reached the minimum at which they can transport freight and passengers at a profit. They are to-day making desperate efforts, in the way of economies, through consolidations and agreements, to reduce expenses sufficiently to make a living profit. Rates, nevertheless, are still too high. The times and the people demand that the charges must be lowered. How is it to be done?

I say we must start afresh—from the ground up—discarding the cumbersome and expensive mode of operation now in use on the steam railroads. We must adopt the electric system, in which each individual car is supplied with its own motive power, and can be run as often as necessary, with nothing to earn beyond its own cost of operation, over a track honestly built and owned by a company capitalized for the actual cost of its plant, with franchise rights for which no money has been paid as tribute to the servants of the people. Those servants have been placed in office by the people to subserve the interests of the people; installation and security in secure place does not mean that a public office is a private enterprise.

I consider the electric system of transportation still in its infancy. What the future will bring forth no man can tell. But to-day it is a living fact, the speed and carrying capacity being limited only to the roadway and the power of the motor. As an example, on the line which I am now building between Philadelphia and New York my roadbed will conform to the highest standard in use by the foremost steam railroads, with one exceptional feature—I shall beat them to the extent that I will not have a single grade crossing. My cars will be comfortable and commodious; and they will have guarantees from the two principal electric companies in this country that their motors will propel the cars at a speed of at least fifty miles an hour. This is no idle dream; it is backed by substantial guarantees from responsible companies.

It is true that I will materially reduce the existing rates of fare between New York and Philadelphia—at the most, I will charge fifty cents—one-fifth of the present tariff—but, at that rate, I do not expect to cripple the steam railroads, or to cut into their normal traffic.

The steam railroads have an established business. It consists of the people who are obliged to travel back and forth between the two places, with a sprinkling of those who travel for pleasure because they can well afford the luxury. The greater portion of this travel, I will admit, will continue to use the steam railroads. But the business which my line will handle will come from people who will travel back and forth because I give them a rate within their means. My lines between Allentown, Philadelphia and New York will serve cities, towns and counties comprising a population numbering, according to the last census, over seven million people. What proportion of these people are now able to go beyond the confines of their own particular community, unless necessity requires them to do so? It is infinitesimal. There are 102 trains, local and through, on each week day, between Philadelphia and New York, in both directions. At the utmost, the average number of passengers originating in Philadelphia and destined for New York, and *vice versa*, does not exceed three thousand per day. Yet, altogether, the combined population of Greater New York and Philadelphia amounts to 4,730,899 souls. Of these three thousand passengers, who travel daily back and forth, a large proportion make frequent trips; another large percentage are inhabitants neither of New York nor Philadelphia; and it is safe to say that 95 per cent of the people of Philadelphia rarely, if ever, have seen the largest city of our country, and 95 per cent of the people of New York have rarely, if ever, seen the birthplace of the nation's independence. But, of that 95 per cent a great number would grasp the opportunity—if the rates of fare were brought to the level of their means.

The material, physical and moral benefits to be derived by communities from low priced long distance transportation service can scarcely be appreciated at the present time. The cheap fare, frequency and accessibility of service, picking up and letting off of passengers practically at the doors of their homes, will create a volume of traffic which cannot be estimated. It will educate the city man by putting him in contact with his country brother. The former will get acquainted with the latter. One will learn the true details of the country and country life; the other will learn of the city and city life. Both must be broadened and benefited.

The electric system will solve the problem of overcrowding in our great cities. It will move the laboring man from the physical and moral unhealthfulness of the congested tenement districts to the pure, clear atmosphere of the suburbs; and it will give the family man of small means a cleanly home in the midst of the world's green fields. The material benefits to be derived from cheap, frequent and easy means of intercommunication between our cities, towns, hamlets and the surrounding country-side should be apparent to the most superficial inquiry.

Travel breeds travel; trade begets trade. When my Allentown system, now comprising 225 miles of track, connecting 66 towns, was started, the road carried in its first year 20,000 people. In the year 1900 it carried over 20,000,000 passengers. A large proportion used the cars going back and forth to their work; but a not inconsiderable number used them for simple pleasure purposes, or on business which might otherwise have been transacted through the mails. These pleasure and business passengers necessarily spend more or less in the community they visit, and acquire in return new trade relations, new ties of friendship, resulting in increased intercommunication, which, growing and growing, works on the principle of the endless chain.

Thus far I have touched on the electric system solely as applied to the transportation of passengers. The true function of the electric line is the carrying of both freight and passengers; not only between cities, but within the cities themselves under conditions and at times that will not interfere with the traffic on the streets. With the proper roadbed and efficient motors, loads equaling the capacity of the largest freight cars can be handled quickly and economically by the electric system. Every car being an individual unit, capable of easy self-propulsion, can be sent singly forward to its destination, without the necessity of making up train loads in order to obtain the maximum load at the minimum cost of operation.

In the beginning, the freight business of the electric lines may be confined to package freight and the country products required daily for the support of the population of the towns and cities.

Excluding the milk traffic, the greater portion of the garden truck supply of large cities is brought within their limits by teams. Electric lines, with far more facility, can handle milk, butter, the products of the farm and truck garden, practically taking them up at the farmyard gates, and delivering them at the door of the consumer. The legitimate freight charges should be about one-third of those exacted by the steam railroads.

The truth of the story of electric traction is the great truth of these latter centuries; scientific advancement means frequent change of conditions, with humanity fitting itself to every new condition, with a gain in material welfare, attended by a gain in moral tone. Steam took a large portion of the space which had been occupied in the world's activities by the horse and the bullock; yet the horse is more bred, and has a higher value than he held one hundred years ago. Electricity takes the place of steam to-day in some of its minor fields, and creates immense new fields, in whose benefits steam roads must share.

Vested interests have ever been, in their origin, the parents of progress; in their maturity, its guardians; in their age, toll takers on its path.

THE PHYSIOLOGICAL EFFECTS OF THE MODERN DEVELOPER.*

WITH regard to the enormous extension of photography, and the consequent enlarged consumption of developers, it is perhaps as well to tabulate experiences as regards the physiological action. These developers are usually in the form of powders or crystals, which for use are dissolved in water with the addition of an alkaline salt, and these solutions come into contact with the hands and fingers of persons who use them. Naturally, it is rare that the developer, as such, or in solution, gets directly into the stomach; but it may be mentioned that some of the developers must be accounted poisons, particularly pyrogallic acid. It is of more interest to the photographer to hear of the conditions under which alkaline solutions of developers produce harmful effects on the skin in the form of a painful exfoliation, which often takes a long time in healing.

Experience shows that only a few individuals possess this special sensibility to these effects. Further, it is undoubtedly certain that they are as likely to be produced by the alkali in the solution as by the developing substance, and only in one single case, metol, do we know definitely that the reagent produces this inflammation and irritation.

Now there is a great difference in the action of alkalies in the developing solution. Reagents, like amidol, which assert their power of developing with the very weak reaction of sodium sulphite only, can be considered harmless. Up to the present no case of irritation is traceable to amidol. The unpleasantness first appears with the employment of the carbonic alkalies in the developer, i. e., sodium carbonate and potassium carbonate, and it is without doubt those developers which require abundant quantities of these alkalies, such as hydroquinone, that have the most unfortunate results, while those which only require small quantities of these alkalies, such as eikonogen and imogen sulphite, can be classed among the harmless.

With the employment of caustic alkalies the peril is again raised; but here it is as well to understand whether the alkali enters into combination with the developer forming a phenolate, or whether it is contained, as such, in the solution with the reagent.

A characteristic case of the first condition is that of rodinal, in which, as is well known, there is only added such a quantity of a caustic alkali as is just sufficient to conduct the change of paramidophenol $\left(C_6H_4\begin{array}{l}OH\\NH_2\end{array}\right)$ into the phenolate $\left(C_6H_4\begin{array}{l}ONa\\NH_2\end{array}\right)$ In this case the corrosive action of the caustic alkali is diminished, and the effect on the skin is reduced to a minimum.

Quite the reverse is the case when the developer is not able to absorb the added caustic alkali by the formation of a new salt, as, for instance, in the case of paraphenylendiamin $\left(C_6H_4\begin{array}{l}NH_2\\NH_2\end{array}\right)$ metacarbol, and in this case solutions of this kind react as strong alkalies, and possess the same corrosive action as equivalent solutions of caustic alkalies; continual working with such a developer is not possible.

* By Dr. M. Andresen, translated in the British Journal of Photography.

SELECTED FORMULÆ.

Milk Stains and Small Grease Spots.—Wash with a rag charged with benzine, dry with a cloth and finally wash with lukewarm water. A similar treatment is effective for stains of stearine or wax.

To Remove Spots.—Faint spots on silk fabrics are removed by mixing borax, 50 grammes; soap, 14 grammes; alcohol, ½ liter; magnesium carbonate, 14 grammes, and yolk of egg, 2 grammes, and applying this to the spots. Allow the liquid to act on them for a while, wash with warm water and rinse with cold water.

Champagne Cider.—To every 8 gallons of sweet, still cider add 2 pints of strained honey, or, in its absence, 2 pounds of sugar; stir well, bung the cask and let stand for eight days. Add 5 fluid ounces of skimmed milk, or 1-3 ounce of dissolved isinglass, and immediately thereafter 2¾ pints of diluted alcohol. Let stand for four days, bunging up the cask tightly.—Pharmaceutical Era.

White Lanolin is produced, according to L. Keutmann, by kneading Adepslanæ anhydricus with hydrogen peroxide instead of with water. The product is of a pure white color and almost entirely odorless. Since hydrogen peroxide is employed as a medicinal remedy, especially as a wound-spray, this lanolin forms an ideal base for skin cream. It cannot be employed, however, in this state as the basis for salves, since the residues of the peroxide would have too violent an action on any admixture.—Pharmaceutische Zeitung.

Varnish Stains.—In the case of wool or cotton, wash first with a sponge saturated with oil of turpentine, then with lukewarm soap water. For silk goods add a little magnesium carbonate to the turpentine oil. If the spots are very old, the fabric should be first moistened with chloroform and treated as pointed out above, only after some time. The oil is allowed to act on the texture for some time, so that the spot becomes softened; after that go over it thoroughly with soap. If the spot has not disappeared, in spite of this, the process must be repeated.—Faerber und Waescher.

To Prevent Coatings on Iron from Peeling off, if exposed to the inclemencies of the weather, it is recommended to wash the iron thoroughly and to coat it immediately after with a layer of boiling linseed oil. If thus treated the coating will never peel off. The process is especially valuable for iron; articles of small dimensions should be previously warmed and dipped into the linseed oil. The boiling oil will enter all the pores of the metal, expelling the moisture therefrom, and the coating adhere so firmly that neither frost nor rain nor wind can injure it.—Kraft und Licht.

Gloss Starch for Linen.—I. Rice starch, 100 grammes; powdered borax, 5 grammes; pulverized boracic acid, 3.5 grammes. Pass all through a hair sieve. II. Powdered starch, 435 grammes; borax, 85 grammes; cooking salt, 10 grammes; gum arabic, white, 75 grammes; powdered stearine, 275 grammes. III. (*a*) Melt together hard paraffine, 2 grammes, and spermaceti, 0.5 gramme; (*b*) Stearine, 4 grammes; hard paraffine, 6 grammes. IV. Melt and stir together, lard, 240 grammes, and butter, 15 grammes; add lemon oil, 5 drops, and a mixture consisting of glycerine, 15 grammes, and strong caustic ammonia, 30 grammes, and beat until the mixture becomes frothy. V. Paraffine, 60 per cent; stearine, 40 per cent. Melting point of the mixture, 45 deg. Centigrade.—Praktischer Wegweiser.

Adhesive for Stove Blacking.—

1.	Ceresine	120 grammes.
	Japanese vegetable wax	100 grammes.
	Oil of turpentine	1,000 grammes.
	Fine lamp black	120 grammes.
	Graphite	100 grammes.

Unite the ceresine and wax by melting, add to the half-cooled liquid mass the lamp black and graphite ground in the oil of turpentine, and stir until completely cool.

2. Mix 2 parts of graphite, 4 parts of copperas and 2 parts of bone black with water, so as to form a creamy paste. This is said to be an excellent polish, as the copperas produces a jet black enamel, causing the graphite to adhere to the iron. Graphite is the principal substance used in a stove polish. Lamp black and other forms of carbon are frequently added to deepen the color, but they are more readily burnt off than graphite.

Cider Phosphate.—A so-called orange cider phosphate may be made by adding to each gallon of finished product from the following formulas about 4 ounces of dilute phosphoric acid or an equal quantity of solution of acid phosphates of the National Formulary:

1.	Sugar	8 av. pounds.
	Water	2¾ gallons.
	Oranges	15

Dissolve the sugar in the water by the aid of a gentle heat, express the oranges, add the juice and rinds to the syrup, put the mixture into a cask, keep the whole in a warm place for three or four days, stirring frequently, then close the cask, set aside in a cool cellar and draw off the clear liquid.

2. Express the juice from sweet oranges, add water equal to the volume of juice obtained, and macerate the expressed oranges with the juice and water for about twelve hours. For each gallon of juice add 1 pound of granulated sugar, grape sugar or glucose, put the whole into a suitable vessel, covering to exclude the dust, place in a warm location until fermentation is completed, draw off the clear liquid, and preserve in well-stoppered stout bottles in a cool place.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

English Demand for Machines for Printing Paper Hangings.—Acting Consul-General Westacott of London, March 4, 1901, reports that he has received a number of inquiries for the names and addresses of firms in the United States manufacturing machines for printing paper hangings. Replies should be sent to the consulate-general.

Typewriters and Adding Machines in Germany.—Typewriters and adding machines have become so indispensable to business concerns in this country, within the last few years, that the former is to be found in every large bureau or office, and no prominent savings or banking institution can do without the latter, says Brainard H. Warner, Jr., Consul at Leipsic. The first typewriters and adding machines used in this country were of American manufacture, and the large increase in their importation caused the German customs officials to place them in a special class on January 1, 1900. Formerly they were assessed for duty under the head of wrought-iron goods.

During the first three quarters of 1900, typewriters and adding machines valued at $562,870 were imported into Germany. The greater part of these machines (39.57 tons, or 75.9 per cent of the whole import) came from the United States; 5.51 tons, or 10.5 per cent, from England; and 5.18 tons, or 10 per cent, from Belgium.

During the same period, the total export of typewriters and adding machines from Germany amounted to 19.73 tons, valued at $213,010. Of this amount, 6.17 tons, or 31.3 per cent, were exported to Austria-Hungary; 3.75 tons, or 19 per cent, to Sweden; and 2.87 tons, or 14.5 per cent, to Russia. Thus the imports exceeded the exports by 32.41 tons in weight and $349,860 in value.

As the manufacture of typewriters in Germany has met with some success and as they are coming more and more into use, some German authorities think it is probable that, in spite of the increasing demand, the import will not increase very materially.

I do not agree with this, however. I think that there is a market in this country, as well as in Russia, Sweden, Austria-Hungary, and England, for American typewriting and adding machines.

The German Toy Industry.—The toy-making industry of Germany has enjoyed great prosperity during the past few years. Cape Colony, British East India, Eastern Asia, North and South America, and Australia buy German toys, and the demand seems to be increasing from year to year. The United States and England are by far the largest purchasers, the shipments to these countries in 1900 having exceeded those of any previous year. Great Britain has bought over 11,000 tons annually during the last few years, and since 1895 has increased her purchases over 1,000 tons. The United States bought 6,195 tons of toys from Germany in 1895 and 9,612 tons in 1900, an increase of 3,500 tons, or more than one-third. The toy manufacturers say that this increase is remarkable, in view of the fact that a few years ago an attempt was made in the United States to prejudice the public against buying German toys by circulating a report that the paint used in their manufacture contained ingredients dangerous to health. The manufacturers declare further that for a time this agitation caused a decrease in the imports of German toys, but since the report was proved to be chimerical, they have apparently found all the more favor in the United States; and last year, there was an immense increase in their importation.

If we compare the total value of the exports of German toys for 1900 (amounting to 53,400,000 marks) with those of 1899 (amounting to 43,000,000 marks), we find an increase that has not heretofore been approached. The year 1899 showed an increase of 4,200,000 marks over 1898, but in 1898 (the exports amounting to 38,800,000 marks = $9,044,000) there was a decrease of 1,500,000 marks in comparison with 1897 (total exports, 40,300,000 marks = $9,606,400). Most of the increase of 1900 over 1899 (10,400,000 marks = $2,475,200) was in the exports to the United States and Great Britain. The exports to the latter country amounted to 16,000,000 marks ($3,808,000) in 1899 and to more than 20,000,000 marks ($4,760,000) in 1900, while the exports to the United States increased from 10,400,000 marks ($2,475,200) in 1899 to about 16,000,000 marks ($3,808,000) in 1900.

The exports to France are also of importance, as they stand third on the list. During 1899, the exports of German toys to France amounted to 1,312 tons, valued at 3,100,000 marks ($737,800); for 1900, however, 1,454 tons, valued at 3,400,000 marks ($809,200). France only imported 810 tons in 1895, but the import since then has been steadily on the increase.—Brainard H. Warner, Jr., Consul at Leipzig.

Improvement in Welsbach Gaslights.—The Welsbach light really became a commercial lighting factor for the first time when Dr. Carl Auer von Welsbach, some ten years ago, brought out what is called the thoria-ceria mantle, which is composed of about 99 per cent of thorium oxide and 1 per cent of cerium oxide. This mixture, in which the thoria is the light-emitting member and ceria the exciter, as it is called, greatly exceeds in light-giving efficiency any of the other mixtures of zirconia, yttria, lanthana, magnesia, etc., which form the basis of mantles made under the earlier Welsbach patents. Naturally, in the invention of an illuminant, the first importance must be given to getting the light; but once this was secured, the inventors and manufacturers began to turn their attention to improving certain features of the mantle which are not of the same highly satisfactory quality as the light emission.

The features which have been particularly the subject of almost endless experiment are the mechanical strengthening of the almost hopelessly weak ashlike structure itself, the prevention of the rapid diminution of the intensity of the light due to the sublimation of the ceria, and the deformation of the mantles due to shrinkage, which fault is to be laid to the thoria itself.

Of course, the chemists busied themselves with the problem of the purification of the constituent materials, and all sorts of attempts were made to better the original ghastly greenish color of the light. Successful chemical purification removed almost entirely the objectionable color and cleared the field for investigation along the other lines; but, despite the legions of patents in all countries and the extravagant claims of inventors, the thoria-ceria mantle, with all its good and bad qualities, holds the market today. Inventors succeeded in exorcising certain of the evil spirits, but usually with the introduction of other and equally sinister demons of their own conjuring.

The manufacturers, on their part, greatly improved the methods of treatment, packing, and shipping of their products, and burners of cheaper and better construction gradually appeared in the market, with the result that the incandescent gas-burner in all its features became standardized and accepted to such a degree that only a new and radically improved method, which would eliminate one or more of the recognized defects of existing mantles, could command any substantial success.

Such a departure has now been made by Mr. Rudolph Langhams, an Austrian engineer resident at Berlin, who has discovered and perfected a chemical complex, which, when added to the thoria-ceria mantle, converts it from a loose, weak, ash structure, scarcely able to sustain its own weight, into an elastic glass, wherein the constituents are chemically combined and not merely mechanically piled together. This chemical binding makes the mantle not only stronger, but it holds the ceria to its work and thereby maintains the constancy of the light emission; and by one of those freaks of fortune that sometimes favor the inventor, it paralyzes the shrinkage tendency of the thoria. So with one stroke, the mantle becomes many times as strong, not to the extent of resembling a wire gauze, but strong enough to withstand use on railway trains; it keeps its candlepower so that after four months of normal usage it is brighter than an ordinary thoria-ceria mantle after a few hours' burning. The shrinkage interests the consumer only indirectly, its effect being to bring the mantle out of the hottest part of the flame and thus help to reduce its candlepower.

The chemical complex which effects this transformation is the silico-zirconate of an alkali—for example, soda—which enters the mantle and unites to form a complex double compound having the nature of a glass, the thorium replacing a portion of the alkali and the cerium also entering the compound, so that the result, chemically expressed, is a seriated silico zirconate of thoria and soda.

However, the compound, as stated, is not necessarily good, but becomes so when the molecular relations of the elements are so adjusted that for each molecule of silicon one molecule of zirconium is present; in other words, the molecular relation of the two acid compounds silicon and zirconium must be closely 1 to 1. This complex is not made separately and added to the complete mantle by dipping the latter in a solution of the former, or any such way; it is formed in the mantle when the latter is made, being added to the thorium-cerium impregnating solution.

A curious phase of this advance is that both silica and zirconia have been used before in mantles, but to no useful purpose, as the former will not unite with the thoria of the mantles unless the alkali is present, and, when used alone by itself without zirconia, gives mantles that almost invariably split open from top to bottom either in manufacture or use. Zirconia by itself serves no useful purpose, its presence being only corrective to the faulty action of the silica, and only properly corrective when the molecular relation 1 to 1 is maintained—too much zirconia causing shrinkage, too much silica splitting.

When once the constituent materials of the mantle are chemically united, further slight improvement can be effected by introducing other elements into the complex—for example, the brittleness in extreme cold weather may be reduced by adding a properly adjusted amount of beryllia and the color and light improved by a slight addition of cobalt. In fact, the door is opened to the correction of minor defects now for the first time given consideration.

The life of these mantles in service is from one thousand eight hundred to two thousand hours. The candlepower at the end of six hundred hours, under conditions of quality and pressure of gas such as are found at Berlin, is as high or higher than the candlepower of a thorium-cerium mantle burning under the same conditions for fifty hours.

As regards shrinkage, this factor is practically eliminated from the new mantle, whereas the thoria-ceria mantles shrink and form what is technically called a "waist" just above the burner after a few hours' duration. Another of the peculiar properties of the new mantle is that during the first ten or twenty hours of use, it actually increases in candlepower, whereas the maximum luminosity of the thorium-cerium mantle is at the moment when it is first lighted.

By reason of their increased mechanical strength, the new burners will be applicable under conditions where hitherto no mantle gaslights have been used—for example, in railway cars and other positions where strong vibration is unavoidable—also all forms of lighting in which gas is burned under excessive pressure and systems in which extra-large mantles are used. This new departure will be of the greatest value, as its increased mechanical strength will materially prolong the life of these mantles, which at present is excessively short and constitutes the main objection to their use. In the manufacturing stage as well, the great strength of the new mantle reduces by 10 per cent or more the loss resulting from breakage. The cost of manufacturing is not increased, as the slight extra expense necessary to carefully adjust the proportions of the mixture is more than compensated by the decreased weight of the mantle itself. Experiments are at present in progress to determine the exact life and characteristics of the new mantles as applied to the comparatively rich American gases, and, so far as they have been conducted, they do not show any marked difference, and there is no reason to suppose the mantle will not be as applicable to American conditions as to those of Germany.—Frank H. Mason, Consul-General at Berlin.

Uses of Turf Fiber.—In a former report from this consulate, the use of turf for paper-making was noticed. Late current publications show an extended and increasing use of turf fibers in the production of various other articles.

The early experiments with turf—some ten years ago—were unsatisfactory. The fibers then obtained were not good spinning material, being hard and brittle and not easily bleached or colored. Later, a civil engineer named Zschörner, in Vienna, succeeded in extracting threads from turf which proved to be good spinning material. He worked by dry process, unaided by chemicals, and succeeded in producing a kind of wool which, though not adapted to the spinning of yarn, is yet so flexible and elastic that large fabrics can be made therefrom. It is characterized also by great absorptivity, is a poor heat conductor, does not burn readily, and is moderately firm and very cheap.

Zschörner next produced turf wadding. This is used as bandages for men and animals, in cases of wounds and the like, and also as a filling for pillows and bed coverings. Then he wove turf yarn into ropes and rugs. The remnants which resulted served for the production of paper and pasteboard.

Karl Geige, in Düsseldorf, has gone still further. He has secured from turf fiber a fine spinning material, which has absorptivity and which also may be bleached or colored. After extracting the vegetable substance, Geige treats it with acids and alkalies, and then boils the resulting liquid, whereby the cells are disorganized and useless substances released and washed out, so that the turf wool consists of almost pure cellulose.

It is affirmed that the Geige turf wool is soft and elastic, with all the good properties of rival products, and in its spinning capability resembles sheep's wool. Clothing materials and different kinds of yarn are made out of this turf product in combination with cotton or sheep's wool. Turf cloth, it is claimed, absorbs perspiration in summer and is warm in winter; felt hats are made out of the turf wool. It is further stated that Geige makes Smyrna and other rugs out of turf wool, which are bleached and colored. In addition to all this, the Geige turf wadding, it is maintained, is not only a cheap, but a very useful, bandage material, because it readily absorbs the secretions of wounds, which are therefore kept always dry and clean. It is further recommended as a substance for laying under very ill persons and as a padding for splints.

If all that is told of this material is true, it will vanquish the old-time sheep's-wool stuffs in the textile field.—Frank W. Mahin, Consul, Reichenberg.

Multiplex Type-Printing Telegraph.—According to the Cologne Gazette, the Baudot multiplex type-printing telegraph (a French invention) operates so excellently that the results in the Berlin and Paris line have surpassed all expectations.

Since the main office has educated a sufficient number of operators for the Baudot apparatus, the system is now regularly in use during the greater part of the day.

It has been demonstrated that the whole telegraph business between Berlin and Paris, which heretofore required five telegraph lines, can now be easily done over one by means of the Baudot system.

The operation is perfect and uninfluenced by minor interruptions of the conduit. The work for the operators is not more arduous than with the Hughes apparatus.

It is to be regretted, says the article, that the new system is not suitable for long cables, otherwise the German-English cable would profit at once.

The new successes in quick and multiplex telegraphy will create a peculiar situation for the administration of the telegraphic service. If the Baudot system be introduced all over Germany, and, in addition, if the quick telegraph of Pollak and Virag be utilized for newspaper telegrams, and if Prof. Slaby succeeds in applying his discoveries concerning multiplex-spark telegraphy to ordinary wires, then it will be only a question of a short time when the existing telegraph business will hardly keep all the lines busy.—Richard Guenther, Consul-General at Frankfort.

New Smelter in British Columbia.—Consul Dudley, of Vancouver, reports, March 13, 1901, that the town of Kaslo has offered a bonus of $50,000 and exemption from taxation for ten years to any person or corporation that will erect a smelter at that place. It is understood that a company has already been organized to build the smelter, and it may be too late for anyone from the United States to take advantage of this offer. But there will undoubtedly, adds the consul, be a market for machinery, materials, and supplies, which enterprising Americans may be able to supply. The construction of the smelter must be commenced before October 1 next. Kaslo is the center of a great silver-lead-producing district, and a smelter ought to be a good paying investment. The consul says that he will be glad to furnish full particulars of the offer, and also regarding the several tributary mines, to persons interested in the matter.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Production of Hydrogen Peroxide Solution.—According to Forgrand the hydrate of sodium peroxide is excellently adapted for the production of hydrogen peroxide solution. Same is obtained by the slow evaporation of an aqueous sodium peroxide solution. According to Harcourt this very constant compound possesses the formula:

$$Na_2O_2 + 8H_2O.$$

When 231 grammes of this hydrate is dissolved in 2 molecules of sufficiently concentrated hydrochloric acid—36.5 grammes = 200 c.cm.—a neutral and perfectly clear hydrogen peroxide solution is immediately obtained without escape of gas, containing 19 to 20 volumes. If 36.5 grammes = 100 c.cm. of hydrochloric acid is used, the contents of water are 30 volumes. The temperature rises but slightly in this production. The sodium chloride also formed does not affect the preparation.—Pharmaceutische Centralhalle.

Glass Plate for Hectographing.—A new German contrivance consists of a faintly ground glass plate upon which writing is done direct with hectographic ink. For the production of a negative a hectograph sheet is stretched over the glass plate, pressed down firmly and drawn off again. The multiplication is accomplished in the customary manner. When the negative does not copy well any more, the hectograph sheet is again laid, by means of a special device, exactly upon the glass plate, and fresh impressions may be made from the same copy sheet. The glass plate is said to render the hectograph mass superfluous.—Technische Berichte.

Varnish from Wood.—Wood consists, essentially, of cellulose, the element of the cell-walls, and lignin, a mixture of substance little investigated chemically. A process patented by Drs. Zühl and Eisemann, of Berlin, has for its object the utilization of this body (lignin), hitherto only known in combination with cellulose, and removed by boiling with sulphite. According to this method, wood is heated with double the bulk of aniline in the pressure-pot to 220 deg. C. Thereby lignin, or the incrusting substances, are separated from cellulose, which latter is said to be obtained as a by-product, but will probably decompose for the most part. Lignin is contained in the aniline in a dissolved state, and is removed therefrom by distilling off most of the latter and adding a suitable precipitant (e. g., ether) to the residue. The eliminated product which still contains a small amount of aniline, constitutes a deep-brown, pulpy mass, which, applied in layers, dries slowly into an elastic, highly lustrous, hard and odorless varnish coat.—Lack- und Farben-Industrie.

Practical Methods to Increase the Durability of Rubber Goods.—A great disadvantage of rubber goods consists in their becoming brittle or sticky very quickly. For the purpose of rendering them soft and elastic again, prepare a moderately strong solution of alum in water, into which lay the rubber articles for a day or two; after that time they are no longer hard or sticky. It is of great advantage for all rubber goods, if seldom used, to be kept in clean water; this will greatly increase their durability. If the objects are not easily placed under water, as, for instance, bicycle tires and similar bulky pieces, it is well to wash them from time to time with water to prevent them from becoming too dry. In this connection it is well to mention that it is harmful for the tires to be tightly inflated over winter and the rubber to touch the floor; the bicycle should rest on a stand or be suspended. Moreover, it should be kept in a dark room in as even a temperature as possible, or at least be provided with a covering of cloth, since air and light exercise an equally destructive action upon rubber.—Allgemeines Journal der Uhrmacherkunst.

Manufacture of Caramel.—Caramel has been employed for some time in considerable quantities as a harmless coloring agent for many purposes. It may be prepared either from sugar or from glucose. The finished material is, in the analysis, tested for coloring power by means of the Lovibond tintometer, for reducing power for Fehling's solution and for solubility in absolute alcohol. The percentage of ash is about 0.8. It is said to be proof against weak organic acids and not to cause turbidness in English beer. The production is effected by heating sugar or glucose in iron or copper vessels with addition of certain salts, ammoniacal salts having been found the best. According to Salamon and Goldin a mixture of ammonium carbonate and ammonium chloride is used in a factory, which is added as soon as the sirup commences to boil, whereupon the boiling is continued for several hours. Next it is cooled with the aid of water. The authors have found that the portion of caramel insoluble in absolute alcohol possesses a greater coloring power than the remainder.—Chemisch-technisches Reportorium.

New Process for the Production of a Weather-proof Coating.—The employment of cement and tar as rust-preventive agents has led to no practical results for the reason that cement cannot be applied in a sufficiently thin layer and easily cracks off in the case of concussions, while tar on the other hand dries only very slowly and usually runs off before drying, owing to the action of the sun. According to a new process by Dr. Hans Loesner of Eisenach, these drawbacks are obviated by first putting on one of the known foundations consisting of cement, silicic acid and a drying oil with or without admixture of pigment, or of basic oxides, providing this ground with a covering of tar or tarry bodies, so that the water-binding qualities of the cement cause the tar to dry, while on the other hand the cement particles by the envelopment in tar substance are rendered fit for a tough coating. A coating prepared by this method is said to be glossy and perfectly dry and to possess the following advantages over others: In the first place a further rusting of the iron under the paint is rendered impossible by the dry cement of the priming coat. By the use of tarry substances the coating becomes highly acid-resisting. The resulting paint cover is very resistive to concussions and fluctuations of the temperature. Instead of cement another substance may also be employed for priming, which possesses the quality of binding water, such as for example lime, gypsum, barium oxide, strontium oxide, aluminium oxide and magnesia.—Neueste Erfindungen und Erfahrungen.

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